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UPDATED COMPUTER PROGRAMS FOR PREDICTING SINGLE EVENT AIRCRAFT NOISE DATA FOR SPECIFIC ENGINE POWER AND METEOROLOGICAL CONDITIONS

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13. ABSTRACT *(Maximum 200 words)*
This report documents OMEGA 10.8 program and OMEGA 11.3 program. These programs were developed to prepare flight and ground run-up noise data for input to NOISEMAP, the Air Force community noise exposure prediction program. All o\routines are documented at a level useful to a programmer working with the code or a reader interested in a general overview of a specific subroutine.

The OMEGA 10 program inputs reference flyover datasets from the NOISEFILE database for a specific aircraft, extrapolates the reference sound pressure level (SPL) data from the reference minimum slant range (1000 feet) to 22 profile distances (200 to 25000), computes the single event measures at these distances, and then applies a set of rules to extrapolate or interpolate these single event versus distance data to produce distance profiles for single event noise measures at the requested power setting, airspeed, temperature and relative humidity.

The OMEGA 11 program inputs reference ground run-up datasets from the NOISEFILE database for a specific aircraft, extrapolates these SPL spectra from the reference distance (250 feet) to each of the 22 profile distance, computes the single event measures for each spectrum at each distance at the requested temperature, relative humidity, barometric pressure and aircraft engine power setting.

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SUMMARY

This report documents version 8 of the OMEGA 10 program and version 3 of the OMEGA 11 program. These programs were developed to prepare flight and ground run-up noise data for input to NOISEMAP, the Air Force community noise exposure prediction program. All routines in each program are documented at a level useful to a programmer working with the code or a reader interested in a general overview of what happens within a specific subroutine.

Both the OMEGA 10 and the OMEGA 11 programs input reference aircraft noise data from the NOISEFILE database. This NOISEFILE database contains reference datasets for both flyover and ground run-up operations for almost all current military aircraft. There are typically three to six flyover and ground run-up datasets for each aircraft where each dataset defines a different engine power setting. The flyover datasets contain seven mean single event measures plus the mean sound pressure level spectrum of peak perceived noise level (PNLM), all normalized to a minimum slant range of 1000 feet, a surface temperature of 59°F and a surface relative humidity of 70%. Each flyover dataset is also normalized to a specific reference airspeed which varies depending on the type of aircraft and the power condition. The ground run-up datasets contain 19 farfield sound pressure level spectra measured at 10 degree increments at a fixed radial distance around one side of the aircraft. These ground run-up data are normalized to a fixed radial distance of 250 feet and to standard day meteorological conditions (59°F, 29.92 inches Hg, 70% relative humidity). The format and content of these normalized reference flight and ground run-up data are defined in Appendices E and G, respectively.

The OMEGA 10 program inputs reference flyover datasets from the NOISEFILE database for a specific aircraft, and extrapolates the reference sound pressure level (SPL) data from the reference minimum slant range (1000 feet) to 22 profile distances (200 to 25000 feet), computes the single event measures at these distances, and then applies a set of rules to extrapolate or interpolate these single event versus distance data to produce distance profiles for up to seven single event noise measures at the requested power setting, airspeed, temperature and relative humidity. The seven single event measures are A-weighted overall sound level (ALX), tone-corrected A-weighted overall sound level (ALTX), perceived noise level (PNLX), tone-corrected perceived noise level (PNLTX), sound exposure level (SELX), tone-corrected sound exposure level (SELTX) and effective perceived noise level (EPNLX). In the print mode, the profile data for all seven measures are always computed and printed and, when requested by the IPU flag, the SELX, ALX and EPNLX data are written to the card image file. In the no-print mode, which is designed primarily to prepare data for input to the NOISEMAP program, only the

one or more SELX, ALX, or EPNLX measures identified on the code sheet are written to the card image file. The content and format of these flight noise profile datasets in the card image file are given in Appendix F.

The set of rules referenced in the above paragraph describe the procedure required to interpolate and/or extrapolate the OMEGA 10 profile data from the given reference data. These rules are defined in the documentation for subroutine SETUPD6.

The OMEGA 11 program inputs reference ground run-up datasets from the NOISEFILE database for a specific aircraft, extrapolates these SPL spectra from the reference distance (250 feet) to each of the 22 profile distances, computes the AL, ALT, PNL and PNLT single event measures for each spectrum at each distance, and then interpolates these reference data to generate similar distance profiles for ALX, ALTX, PNLX, and PNLTX at the requested temperature, relative humidity, barometric pressure and aircraft engine power setting. As in the OMEGA 10 program above, print flags are defined to control the type and quantity of data printed on the output and card image files. The format and content of these ground run-up noise profile data are described in Appendix H.

The profile datasets written in the card image files as described in the above programs are the primary aircraft noise data used by the NOISEMAP program to generate noise profiles around a specific airbase. With these programs these noise data can be tailored to the specific weather and aircraft flight and ground run-up power conditions for that airbase which will, in turn, improve the accuracy of the noise contours produced by the NOISEMAP program.

The remaining appendices in this report contain the following items for both the OMEGA 10 and OMEGA 11 programs:

(a) a complete source listing;
(b) the program code sheet and the procedure for setup and execution of the program;
(c) a complete sample run including a listing of all input and output data.

Appendix K is a user's guide for the MENU108 program which can be used to interactively setup and execute the OMEGA 10.8 program. This MENU108 program also enables the operator to select specific noise measure profiles which are then written to the display for easy comparison.

A similar MENU113 program is being developed to setup and execute the OMEGA 11.3 program. MENU113 will display noise measure profiles for 22 distances for selected angles as well as noise measure data for all available angles for selected distances. This MENU113 program is not complete at this time and thus is not included in this report. When this MENU113 program is available, it will present menus which are very similar to the MENU108 menus described in Appendix K.

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PREFACE

This updated report documents the OMEGA 10.8 and OMEGA 11.3 computer programs which were developed to prepare aircraft flyover and ground run-up data for input to the NOISEMAP program. This work was performed for the Noise Effects Branch of the Armstrong Laboratories at Wright-Patterson Air Force Base, Ohio. The contract monitor for this effort was Mr. Jerry Speakman.

Special thanks are due to Mr. Jerry Speakman and Mr. Robert A. Lee for their guidance and assistance in this effort.

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INTRODUCTION

This report contains the complete documentation of the OMEGA 10.8 and OMEGA 11.3 programs. Included in Appendices are the program source listings, input parameter code sheets with standard procedures for setup and execution of each program, format descriptions for all input and output records, and input and output sample test data. Both programs were originally written in CDC FORTRAN Extended (FORTRAN IV) for the CDC CYBER 74 and CYBER 750 in the ASD Computer Center at Wright-Patterson Air Force Base. Both programs have been modified to run on an IBM compatible PC with a Lahey FORTRAN compiler. With several minor changes, both programs can also be compiled with Microsoft FORTRAN Version 5.0.

These programs were developed by the University of Dayton Research Institute (UDRI) and the Air Force Aerospace Medical Research Laboratory (AFAMRL) to prepare flight (OMEGA 10) and ground run-up (OMEGA 11) noise data for input to NOISEMAP, the Air Force community noise exposure prediction program. Both programs input reference datasets from the NOISEFILE database and interpolate or extrapolate the profile measure data at the requested power settings and meteorological conditions. These flight and ground run-up reference data in NOISEFILE were computed by the OMEGA 6 and 8 programs, respectively. Some of the analysis procedures used in these programs are described in AMRL-TR-73-107.[1]

The OMEGA 10 program inputs all flight noise reference datasets from NOISEFILE for the aircraft being analyzed. This flight noise NOISEFILE database is opened with Unit 7 in the program. These flight reference datasets contain seven mean single event measures plus the mean sound pressure level spectrum of perceived noise level (PNLM), all normalized to 1000 feet minimum slant range at standard day meteorological conditions (59°F and 70% relative humidity). A description of the format and content of these reference datasets is given in Appendix E. These reference data are used to compute the ALX, ALTX, PNLX, PNLTX, EPNLX, SELX, and/or SELTX profile data at the reference power setting for the profile output meteorological conditions. These reference power profile data are then used to interpolate and/or extrapolate the profile data to the requested power setting and airspeed. These final profile data are printed in tabular form on the OUTPUT file and/or written to the file opened on Unit 3 in the format required by the NOISEMAP program. Since only the ALX, SELX, or EPNLX data are used by the NOISEMAP program, only these profile datasets can be written to the file opened on Unit 3.

A description of the format and content of this Unit 3 file is given in Appendix F. A complete sample problem with a listing of all input and output data is given in Appendix C.

The OMEGA 11 program inputs all ground run-up noise reference datasets for the aircraft being analyzed from file NOISEFILE which is opened on Unit 7. These reference datasets contain spectral data at 10° angular increments for angles 0 to 180 degrees at a specific power setting and standard reference distance (250 feet) and for standard day meteorological conditions (59°F, 70% relative humidity, and 29.92 in. Hg.). The format and content of these reference datasets are described in Appendix G. These reference SPL spectra are then used to extrapolate spectral data for the same angles at 22 standard profile distances for any reasonable meteorological conditions, all at the reference power settings. These extrapolated spectral data are used to derive PNLX, PNLTX, ALX and ALTX data for each angle and profile distance. These PNLTX, ALX and ALTX data for two power settings are then used to interpolate the final ground run-up noise profile data required by the NOISEMAP program; they are written to a file on Unit 2 in the format described in Appendix H. A complete sample problem with a listing of all input and output are given in Appendix D.

The profile datasets written to files on Units 2 and 3 as described in the above programs are the primary aircraft noise data used by the NOISEMAP program to generate noise profiles around a specific airbase. With these programs these noise data can be tailored to the specific weather and aircraft flight and ground run-up power conditions for that airbase which will, in turn, improve the accuracy of the final noise contours.

GENERAL OVERVIEW OF THE OMEGA 10 PROGRAM

The OMEGA 10 program, hereafter referred to as simply the "program", is designed to compute descriptions of the noise of an aircraft in terms of A-weighted overall sound level (ALX), tone-corrected A-weighted overall sound level (ALTX), perceived noise level (PNLX), tone-corrected perceived noise level (PNLT), effective perceived noise level (EPNLX), sound exposure level (SELX), and tone-corrected sound exposure level (SELTX) as a function of slant distance to the aircraft, aircraft power setting, and aircraft airspeed. These noise measure data (profile datasets) are computed for aircraft flyover tests as outlined in AMRL-TR-73-107.[1] The EPNLX, SELX and/or ALX profile datasets are required as input to the NOISEMAP noise exposure forecast program.

To compute the above integrated noise measures at the requested meteorological conditions and for each power setting (PSC) and airspeed requested on the code sheet, the program first reads in all reference file datasets for aircraft ACC. A description of these reference datasets is given in Appendix E. Each reference SPL spectrum is then extrapolated to each of the 22 standard slant distances and to the requested temperature and relative humidity from which PNLX, PNLTX, ALX and ALTX noise measures are determined. These four extrapolated noise measures as well as the mean PNLA, PNLTA, ALA, and ALTA data computed from the mean reference spectrum and the mean EPNLA, SELA, and SELTA data from the reference dataset are used to compute the PNLX, PNLTX, ALX and ALTX single event measures and the EPNLX, SELX and SELTX integrated measures at each distance, power setting, and airspeed. The final profile noise measures are then interpolated or extrapolated from these single event noise data using the rules established for the specific data type.

The program prints plots and/or listings of almost all of the above input and computed data. The following is a summary of the program operations:

(1) The program reads the code sheet input data and all reference datasets for aircraft ACC and initializes numerous test variables.

(2) The program (subroutine SETUPD6) determines which reference file datasets are required to compute the requested profile data at each power setting.

(3) The cover page is printed when IPR>0.

(4) The PNLA, PNLTA, ALA and/or ALTA data are computed from each reference spectrum used in the analysis.

(5) A plot of the reference spectrum is printed on Page G (IPR>O).

(6) The PNLX through SELX (7 measures) single event noise measures are computed from the 22 extrapolated SPL spectra for air-to-ground and ground-to-ground propagation for the reference dataset power setting and program reference airspeed (250 knots). Computer listings of the SPL spectra plus these seven single event measures at each distance and plots of these single event measures, all at the reference file power setting and airspeed, are printed only when IPR>0 for the NP=0 option.

(7) The interpolation and extrapolation rules are then applied to compute the final profile data for one or more single event measures at each power setting (PSC). Computer listings and plots of these profile data are printed only when IPR equal one.

(8) These EPNLX, SELX and/or ALX profile data are written to a file on Unit 3 when IPU is greater than zero. A complete description of these profile datasets is given in Appendix F. Since the remaining PNLTX, PNLX, SELTX and ALTX measures are not used as input to the NOISEMAP program, they are not written to the file on Unit 3.

(9) The final summary page is always printed.

(10) After all data are analyzed for all aircraft or when an error occurs, the program terminates with a call to EXIT where the argument is one when an error has occurred or zero when there is no error.

Examples of all the above plots and listings are presented with the sample problem in Appendix C. When IPR is less than one, only the summary page plus any error messages are printed on the OUTPUT file. For IPR greater than zero, all single event measures are always computed (all MEAS are set equal to one), while, for IPR equal to zero, only the requested measures (MEAS>0) are computed (default is SELX).

The CDC FORTRAN Extended (FORTRAN IV) computer language was used for the original version of this program. The common and subroutine features of the language were used extensively throughout the program to save computer time and memory.

Over the past ten years, this program was converted from CDC FORTRAN to FORTRAN 77 for the Perkin-Elmer and later to Microsoft and Lahey FORTRAN for the PC. Version 10.8 is currently being compiled with the Lahey compiler.

The following sections describe the detailed tasks accomplished by the program. It is intended to document the procedures within each subroutine at a level useful to either a programmer reading this while working with the code or a reader simply interested in what happens with a specific subroutine. The algorithms used to compute the noise measures are described in detail in the individual subroutines.

Note that Appendix K contains a user's guide for the MENU108 program. The MENU108 program can be used to interactively setup and execute the OMEGA 10.8 program as well as perform some post-processing of the noise measure profiles.

GENERAL ORGANIZATION OF THE OMEGA 10 PROGRAM

The general organization of the entire program is shown in Figure 1. The diagram indicates access to the various routines rather than program flow; for example, MAIN calls subroutine CDIST which in turn calls subroutines CPNL, CPTC and CAL and subroutine CPNL calls function FNOY. In general, program flow is from left to in this diagram. Function ICV is called numerous times from the MAIN routine and from subroutines OUTG, OUTH, OUTJ, DELTA6, and SETUPD6.

Using Figure 1 as a guide, this section summarizes in very general terms the functions performed by the entire program. This is meant to serve as an introduction for the reader to the functions of the individual subroutines.

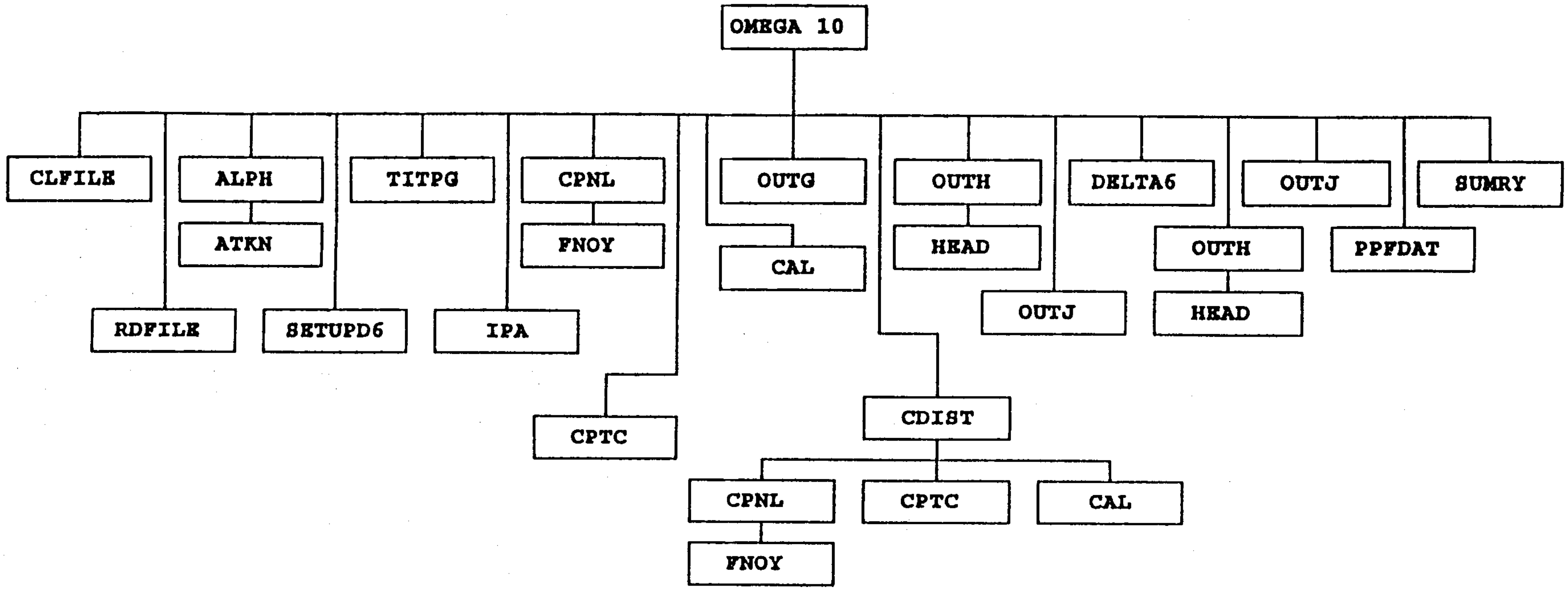
The control routine, MAIN, reads the job control record, the aircraft code sheet record, and the operation power information record (or records). The required input and output files are opened in routines CLFILE or RDFILE. For non-standard temperature and humidity, subroutine ALPH is called to compute the atmospheric absorption data. Numerous program and test variables are initialized at the beginning of the MAIN routine.

Next the program reads all reference datasets for aircraft ACC from the reference file opened on Unit 7. These datasets are checked for errors which will result in the aircraft data being deleted from the job. At the end of the dataset input, subroutine SETUPD6 is called to determine which datasets are required to compute the profile data at each requested output power setting (PSC).

Subroutines TITLE and IPA are called (for IPR>0) to print the cover page and initialize plot arrays used in subroutines OUTG and OUTJ.

Subroutines CPNL, CPTC and CAL are called to compute the PNLA, C and ALA data for each reference spectrum; the PNLTA and ALTA data are then computed in the MAIN routine. Subroutine CPNL uses function FNOY to compute the noy data for each SPL level. These data as well as a plot and listing of the reference SPL spectrum are printed on output Page G by subroutine OUTG (IPR>0).

Subroutine CDIST is called for each reference power setting (reference dataset) and each type propagation (air-to-ground and ground-to-ground) to extrapolate the SPL reference spectrum to 22 standard profile distances at a selected temperature and humidity, compute



Note: Function ICV is used in numerous routines throughout the program. Data are written to the list file opened on Unit 6 by many routines. The Main OMEGA10 routine reads from files opened on Units 5 and 7. Routine PPFDAT writes the profile datasets to the file opened on Unit 3.

Figure 1. General Organization of the OMEGA 10 Program.

PNLX, PNLTX, ALX, ALTX and C for each extrapolated spectrum, compute the SELX, SELTX and EPNLX measures for each distance at the reference file airspeed, and finally compute the smoothed EPNLX, SELTX, PNLTX and ALTX data. These final EPNLX, SELX and SELTX profile data are adjusted to the program reference airspeed (250 knots). Then all seven profile measures are stored in arrays PRDA (air-to-ground) and PRDG (ground-to-ground). This subroutine calls subroutines CPNL, CPTC, and CAL to compute the above PNLX, C and ALX data. Subroutine CPNL also uses function FNOY to compute the noy data required by the PNLX algorithm.

When the program is in the print mode (IPR>0) with the NP=0 option in effect, listings of the extrapolated SPL spectra and the single event data (PNL etc.) for each distance are printed by subroutine OUTH. The SPL spectra are printed on output Pages H and L for air-to-ground and ground-to-ground, respectively; the single event data are, likewise, printed on Pages I and M. Subroutine OUTH calls subroutine HEAD to print each page header block. Also plots of these same single event data are printed by subroutine OUTJ. The air-to-ground PNLTX, PNLX, ALX and ALTX single event data are plotted on output Page J and the SELTX, SELX and EPNLX, single event data on Page K. The corresponding ground-to-ground single event data are plotted on Pages N and O. All these data are computed at the reference power setting and airspeed.

When the program is in the print mode but with NP>0, the final profile data for the seven single event measures for each requested power setting (PSC) and airspeed (VX) are computed by subroutine DELTA6. These data are computed by applying the a set of rules to extrapolate or interpolate these data from the reference data. Once again, listings and plots of these single event measures are printed by subroutines OUTH and OUTJ, respectively.

In the no print mode (IPR=0) for all NP, the program only computes the single event measures requested by the MEAS code sheet parameter plus all other data required to compute this requested measure. No plots or listings are printed and subroutines OUTH and OUTJ are not called.

Next, when the program is in the profile dataset mode (IPU>0), subroutine PPFDAT is called to write one or more of the EPNLX, SELX and ALX single event measures to the profile dataset file (Unit 3) in the standard profile dataset format (Appendix F). Finally, the summary page is printed and program control is returned to label 10 to begin the next aircraft analysis or terminate the job. Note that the PNLTX, PNLX, SELTX, and ALTX single event measures can not be written to the profile dataset file on Unit 3.

DEFINITIONS OF SYMBOLS AND TERMINOLOGY USED IN THE OMEGA 10 PROGRAM

The symbols defined here are used in this report and/or in the OMEGA 10 program source listing. Some of the symbols used in the program are really dummy variables used in only one or two routines and redefined in each routine; most of these symbols are not included in this list of symbol definitions. Symbols which are arrays will be listed with their array dimensions. Variables I, J, and L are usually (but not always) used as array subscripts as follows:

(1) The subscript "I" is a running index associated with any one spectrum or standard profile distance.

(2) The subscript "J" is a running index associated with any one band in the set of 1/3 octave frequency bands.

(3) The subscript "L" is a running index associated with any one power setting.

SYMBOL	*DESCRIPTION*
AC	Aircraft name (10 characters or less),
ACC	Aircraft code (3 characters -- see code sheet).
ALA(15)	Mean reference A-weighted overall sound level in dBA.
ALTA(15)	Mean reference tone-corrected A-weighted overall sound level in dBA.
ALTX(22)	Profile tone-corrected A-weighted overall sound level for each distance for the reference power setting and airspeed in dBA.
ALX(22)	Profile A-weighted overall sound level for each distance for the reference file power setting and airspeed in dBA.
ATNC(31)	Atmospheric absorption coefficients for the OMEGA 10 profile output (ITEMP and IRHUM) in dB per 1000 feet.
ATNR(31)	Atmospheric absorption coefficients for standard day conditions (59°F and 70%) in dB per 1000 feet.
AW(31)	A-weighting coefficients in dB.
BLK	A data statement variable carried in OUTC labeled common containing a blank Hollerith character. It is used to print variable format data and initialize numerous program variables.
COMD(15)	Last five characters of each reference file dataset COMDECK name.
CRI	Comdeck revision identifier (see code sheet).
D2X(22)	Factor to adjust the measure data to the correct profile slant distance.
DATE	Date of computer run (see code sheet).
DATEN	Date of computer run in numeric form which is used as part of the data identification code on tab plots and in the reference dataset (see code sheet).
DELN	Noise adjustment factor added to each band in the reference spectrum (dB).
DG	Ground-to-ground propagation adjustment factor.
DRAG(3,15)	Drag configuration read from the reference dataset and printed on output Page G.
EA(22,24)	Excess atmospheric attenuation in dB for bands 17 to 40 and distances 200 to 25000 feet.
EPNLA(15)	Mean reference effective perceived noise level for each power condition in EPNdB.
EPNLX(22)	Profile effective perceived noise level in EPNdB for each distance for the reference power setting and airspeed.

SYMBOL	*DESCRIPTION*
ERRFLG	Logical variable which is set to .TRUE. when there is an error in an OMEGA 10 run. This is used by the NOISEMAP MCM to detect an error.
ET(2)	Engine type read from the reference dataset and printed on Page G and on the second profile dataset comment card.
EXTMX	Maximum permitted extrapolation from the reference value at a slant distance of 1000 feet for the first air-to-ground measure (EXTMX=5.0 dB).
FJ	Constant used in the perceived noise level computations; FJ=0.15 for 1/3 octave band data.
FL(24,5)	Data statement array used in noy computations (function FNOY) containing the band sound pressure levels in dB given in Table 4.
FM(24,4)	Data statement array used in noy computations (function FNOY) containing the reciprocals of the slopes given in Table 4.
FREQ3(31)	Geometric mean and lower limiting frequencies required to compute atmospheric absorption coefficients for 1/3 octave data.
H0	Reference minimum slant range for the power setting being computed.
IBNH	Largest band number index (31 corresponds to band 40).
IBNL	Initial band number index (1 corresponds to band 10).
ID	Variable frequently used to identify the SPL data to be used in the specific computations.
IMS(15)	Reference minimum slant range in feet for each power setting.
IORD(35)	Plot ordinate scale values.
IPAGE	Part of page number identification.
IPR	Program print control flag (see code sheet).
IPROP	Propagation type code; 1 for air-to-ground and 2 for ground-to-ground.
IPTC	Index of band which determines the tone correction for the reference distance profile spectrum.
IPU	Program profile dataset print (file on Unit 3) control flag (see code sheet).
IRD	Profile distance index which corresponds to the reference minimum slant range.
IREQ(15)	Program flag used to indicate which reference data are required to compute the requested profile output.

SYMBOL	*DESCRIPTION*
IREQC(7,15)	Indices of reference power setting and two slope power settings required to compute the profile output for each requested power setting. See subroutine DELTA6 for the complete definition.
IRHUM	Reference relative humidity in percent.
ISEQD(7)	Data statement array in subroutine OUTH containing the indices of the measure data in array SENX in the sequence required for printing.
ISRC(31)	Integer value of mean reference data.
ITEMP	Reference surface temperature (°F).
IV(15)	Reference aircraft velocity in knots for each power setting.
IVER	Program version code.
IVX	Integer value of the reference or profile aircraft velocity in knots.
LFLG(15)	Program flag used to flag profile data when the extrapolation limit is exceeded or when data are omitted because of extrapolation problems.
LIM	Extrapolation check flag. Extrapolation is checked only when LIM=1.
MEAS(3)	Program control variable used to select the profile measures for the no-print mode (see code sheet).
MM	Maximum number of reference power settings per aircraft (MM=15).
N	Number of reference file power settings read from NOISEFILE for aircraft ACC.
NFFLY1	Character (*24) variable used to store the first of two reference dataset files name.
NFFLY2	Character (*24) variable used to store the second reference dataset file name.
NP	Number of output power settings for which profile data are requested for this aircraft.
NPM	Maximum NP permitted by the program (NPM=15).
NR(15)	Number of runs (measure locations) averaged to obtain the given reference data for each power setting (the reference data were computed in the OMEGA 6 program).
OPC(15)	Operation power code for each reference power setting.
OPCC(15)	Operation power code for each profile output power setting.
OPCD(15)	Data statement array containing the default profile output operation power codes.

SYMBOL	*DESCRIPTION*
OPCR(15)	Operation power code for the reference data from which the OPCC data are computed and the operation description taken.
OTC	Operation type code.
P(2,15)	Power setting description data for each reference power setting.
PC(2,15)	Power setting description data for each profile output power setting.
PNLA(15)	Mean reference perceived noise level in PNdB for each power setting.
PNLTA(15)	Mean reference tone-corrected perceived noise level in PNdB for each power setting.
PNLTX(22)	Profile tone-corrected perceived noise level for the reference power setting and airspeed in PNdB.
PNLX(22)	Profile perceived noise level for the reference power setting and airspeed in PNdB.
PRDA(22,15,7)	Profile data for EPNLX, SELTX, ..., ALX for air-to-ground propagation for each reference power setting and adjusted to the program reference airspeed (RV).
PRDC(22,7,2)	Final EPNLX, SELTX, ..., ALX profile data for air-to-ground and ground-to-ground for one power setting (computed by subroutine DELTA6).
PRDC(22)	Array used in subroutine DELTA6 to compute the profile data for one specific measure and type propagation.
PRDG(22,15,7)	Same as PRDA above except for ground-to-ground data.
PRDI(22,15)	Array equivalent (subroutine DELTA6 argument) to specific elements of array PRDA or PRDG. Contains all available profile reference data for one measure and one type propagation.
PS(2,15)	Reference power setting data (value and units in character format) for each reference operation power code.
PSC(15)	Profile output power setting for each requested operation power code in character format (see code sheet).
PSCF(15)	Same as PSC(15) except in numeric format.
PSIF(15)	Reference power setting in numeric format.
PSU	Power setting units for this aircraft.
PTC	Tone correction in dB.
PV	Profile version code (see code sheet).
RV	Program reference airspeed in knots (RV=250).

SYMBOL	*DESCRIPTION*
SELA(15)	Mean reference sound exposure level in dB for each power setting.
SELTA(15)	Mean reference tone-corrected sound exposure level in dB for each power setting.
SELTX(22)	Profile tone-corrected sound exposure level in dB for a specific reference power setting and airspeed.
SELX(22)	Profile sound exposure level in dB for a specific reference power setting and airspeed.
SENX(22,7)	Array equivalent to arrays PNLTX(22) through SELX(22) in blank common.
SOURCE(2,15)	Identifies the program and date from each reference dataset.
SPLA(15,31)	Mean reference sound pressure level in dB for each power condition.
SPLX(22,31)	Profile sound pressure level in dB.
SR(15,40)	Mean reference data for each power condition; equivalent to arrays SPLA through CA in blank common (see subroutine CDIST) .
SX(22)	Distance data in feet for the 22 profile distances.
THETA(15)	Mean reference angle of maximum radiation in degrees for each power condition (directivity angle).
TYPE(15)	Character variable used to store the interpolation code (I, N, or P) for each reference dataset.
VFCT	Variable used to adjust aircraft airspeed from reference dataset airspeed to program reference airspeed or from program reference to final profile airspeed.
VREF	Floating point value of the aircraft reference airspeed (IV).
VX(15)	Aircraft airspeed in knots for each profile power condition.

DETAILED DESCRIPTION OF THE OMEGA 10 PROGRAM

This section discusses the MAIN routine and each subroutine in the OMEGA 10 program. Procedures within most routines are documented at a level useful to a programmer reading this while working with the code or a reader interested in what happens within a specific subroutine. Most routines contain numerous comments which should be very helpful in following the code.

The program algorithms and I/O are discussed in the routines in which they are coded. The program code sheet in Appendix A and the sample problem in Appendix C are referenced to simplify the description of the input and output. The more complex subroutines are supplemented by flow charts drawn from the point of view of function performed rather than block instructions.

COMMON VARIABLES

Extensive use is made of common in the program for communications between the various routines. Many of the storage locations in blank common are used in different ways or with different variable names throughout the program. This was done to reduce the memory required to run the program on the old CDC computers. Several of the large arrays are included in blank common rather than labeled common because on the CDC CYBER computers a large blank common reduces the total memory required to load and execute the program. The variables used in labeled common are usually of a similar type and/or used in many of the same subroutines.

The variables assigned to blank and labeled common in the MAIN routine and the total common length are listed in Table 1. The subroutines in which the labeled common are used are listed in Table 2. All blank and labeled common are included in the MAIN routine. All common variables are defined in the complete list of symbols in the previous section of this report. The blank and labeled common are described in the following paragraphs.

Blank Common

The 24,420 bytes used by blank common in the main routine is the maximum required in any routine in the program. Almost all routines use some blank common but only a few require the 24,420 bytes. The variable names assigned to blank common vary throughout the program. Most variables are defined to communicate with several subroutines and then redefined for the next series of routines.

TABLE 1

MAIN ROUTINE VARIABLES IN BLANK AND LABELED COMMON

		Labeled Common				
	Blank Common	HEADC	COMPC	OUTC	CHAR	ERRORS
	IBNL	IPAGE	IV(15)	ISC(9)	AC	ERRFLG
	IBNH	IVX	IMS(15)	IORD(35)	ACC	
	L	ITEMP	PSIF(15)		BLK	
	SR(15,40)	IRHUM	PSCF(15)		CRI	
	NR(15)	IVER	IREQC(7,15)		DASH	
	ISRC(31)	OTC	VX(15)		DATE	
	SPLX(22,31)		SX(22)		DATEN	
	PNLTX(22)		ATNC(31)		DOT	
	PNLX(22)		ATNR(31)		ET(2)	
	ALTX(22)		DELN		OPC(15)	
	ALX(22)		IPTC		OPCC(15)	
	EPNLX(22)		IPROP		OPCD(15)	
	SELTX(22)		MEAS(3)		OPCR(15)	
	SELX(22)				ORD(43)	
	PRDA(22,15,7)				P(2,15)	
	PRDG(22,15,7)				PC(2,15)	
					PP(84,3)	
					PS(2,15)	
					PSC(15)	
					PSU	
					PV	
					X	
Length in Bytes	24420	24	1080	176	1331	4

TABLE 2

SUBROUTINES CONTAINING THE LABELED COMMON

HEADC	COMPC	OUTC	CHAR	ERRORS
HEAD	CDIST	IPA	HEAD	SETUPD6
OUTG	HEAD	OUTG	IPA	CLFILE
OUTJ	OUTG	OUTH	OUTG	RDFILE
PPFDAT	OUTJ	OUTJ	CDIST	
SUMRY	PPFDAT	BLOCK DATA	OUTH	
TITPG	SETUPD6		OUTJ	
BLOCK DATA	SUMRY		PPFDAT	
	BLOCK DATA		TITPG	
			SETUPD6	
			DELTA6	
			SUMRY	
			BLOCK DATA	

CHAR Common

This CHAR labeled common was added to the program when the program was converted to the FORTRAN 77 and rehosted to an IBM compatible PC. All variables in this labeled common are character variables which were previously used in the HEADC, COMPC and OUTC labeled common. The character and numeric variables were separated at that time with all character variables being put into the CHAR labeled common. No effort was made to group these variables in any other way.

COMPC Common

These variables are a combination of output variables and variables required to compute the profile data or both. The variable names are the same throughout the program.

ERRORS Common

The error flag variable stored in this labeled common is used only in the main routine and in subroutines RDFILE, CLFILE and SETUPD6. It was added in OMEGA 10, Version 8 to flag errors as required in the NOISEMAP MCM.

HEADC Common

These variables are primarily output variables required to identify the data being analyzed. Most of these data are printed in the page header blocks, the plot identification blocks, and the output COMDECK comment records. The variable names are the same throughout the program.

OUTC Common

These variables are required to set up and print the listings and plots in subroutines OUTG, OUTJ and OUTH. If all listing output are deleted (e.g., in some future preprocessor version of this program), this common statement will no longer be required. These storage locations are defined the same throughout the program.

MAIN PROGRAM

MAIN is the executive routine for the entire OMEGA 10 program. Its principal function is to call the subroutines required to compute the aircraft analysis. However, it also reads all the aircraft setup (code sheet) data, initializes numerous program and aircraft variables, and reads and checks the reference file (Unit 7) input data. The MAIN routine is discussed in the following paragraphs using the program listing in Appendix I and the flowchart in Figure 2 as a guide.

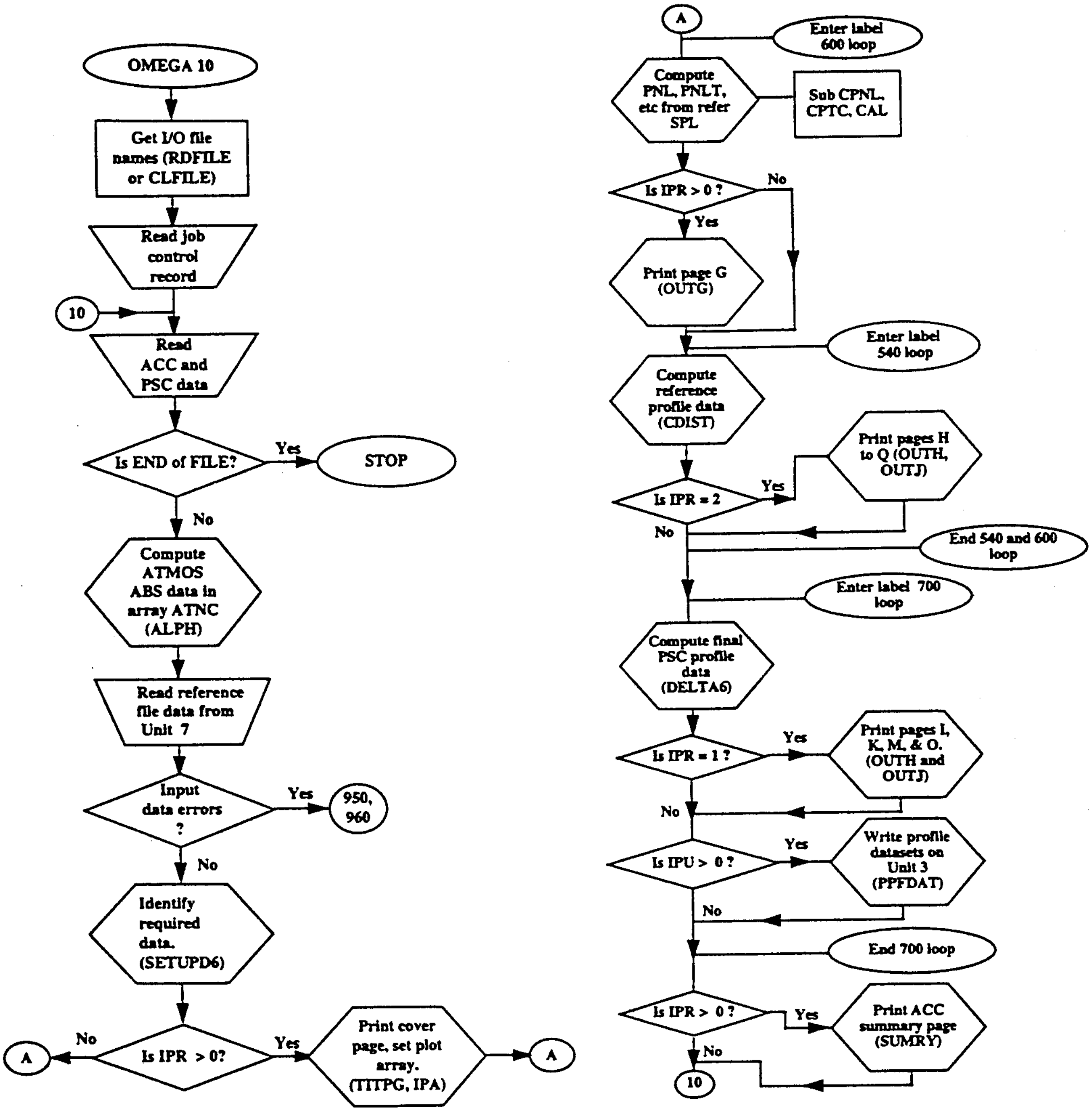


Figure 2. Flowchart for OMEGA 10 MAIN Routine.

Method

The first segment of the MAIN routine, from the beginning to label 150, performs the following data input and initialization steps:

(1) The Lahey FORTRAN routine GETCL is called to get the execution statement command line arguments. If the command line is empty, subroutine RDFILE is called to query the operator for the setup file name and the profile dataset file name. When the command line is empty, the list output is always written to OMEGA108.OUT and the reference databases are always assigned to file names NM63FLY1 and NM63FLY2. These list and reference database files will change when the program and database versions change. If the command line is not empty, subroutine CLFILE is called to parse the five file names on the command line. The command line must contain all five I/O file names as described in the documentation for subroutine CLFILE.

(2) Numerous program and aircraft variables are initialized. The SX array is initialized to the 22 standard profile distances:

$$SX_I = \text{antilog}\ (\frac{I + 22}{10}) \qquad \text{feet}$$

where I is the standard distance index (I = 1 to 22).

(3) The job control record is read and default values are set when they apply. For IPR equal to zero or blank (no-print mode), the IPU flag is always set equal to one and, if all MEAS are blank, $MEAS_3$ is set equal to one (SELX). For IPR equal one (print mode), all MEAS flags are set equal to one (all three measures are always computed).

(4) The aircraft setup records for aircraft ACC are read and additional aircraft default parameters are set.

(5) The atmospheric absorption coefficients are computed for non-standard temperature and relative humidity. The coefficients for standard conditions (59°F and 70%) are stored in the ATNR data statement array.

(6) The reference dataset file is opened and searched for all reference datasets for aircraft ACC. All data for aircraft ACC must be back-to-back in the reference file. A maximum of fifteen (MM) are read and stored in the program. If several datasets

with the same operation power code (OPC) are in the reference file, the last dataset for this OPC is stored in the program. These reference datasets are checked for errors in aircraft code, operation power code, and record sequence number; an error will abort this aircraft analysis (not the entire job). It should be noted here that the current version of OMEGA 10 (Version 8) defines two reference dataset files in variables NFFLY1 and NFFLY2. The file named in variable NFFLY1 is opened for military aircraft which includes aircraft codes less than 200 or greater than 349. The file named in variable NFFLY2 is opened for civil aircraft with codes from 200 to 349. These aircraft code numbers as well as the number of reference dataset files may change in future versions of this program.

After all input data are read and checked, the program calls subroutine SETUPD6 to apply the interpolation/extrapolation rules in the selection of the one, two, or three reference datasets required to compute the profile output dataset for each power setting (PSC). The indices of these reference data for each PSC are stored in array IREQC. Also flag array IREQ is set equal to one when the corresponding reference dataset is required to compute profile data. The IREQC and IREQ arrays are defined in greater detail in comment statements in subroutines SETUPD6 and DELTA6.

For IPR greater than zero, the cover page is printed by subroutine TITPG and several plot arrays used to print the plots in subroutines OUTG and OUTJ are initialized by subroutine IPA.

The label 600 loop performs the following operations for each of the N reference dataset power settings (IREQ>O) required to compute the requested profile noise data at the PSC power settings:

(1) Subroutines CPNL, CPTC and CAL are called to compute the perceived noise level (PNLA), tone correction (C or PTC), and A-weighted overall sound level (ALA) from the reference SPL spectrum for the L^{th} power setting. The PNLA data are stored in $SR_{L,33}$ and the ALA are in $SR_{L,35}$ The tone-corrected perceived noise level (PNLTA) is:

$$SR_{L,34} = SR_{L,33} + PTC \qquad \text{PNdB}$$

and the tone-corrected A-weighted overall sound level (ALTA) is:

$$SR_{L,36} = SR_{L,35} + PTC. \qquad \text{dBA}$$

(2) Subroutine OUTG prints (for IPR>0) a plot and listing of the SPL reference spectrum and prints the data computed in step 1 above, the EPNLA, SELA, SELTA and THETA from the reference dataset, and numerous additional identification parameters, all for the L^{th} reference power setting.

(3) The 540 loop calls subroutine CDIST to compute all SPL and single event data for air-to-ground and ground-to-ground propagation. Subroutine CDIST extrapolates the reference SPL spectrum to each profile distance and then computes all single event data for each distance. Subroutine OUTH prints listings of these SPL and single event data and subroutine OUTJ prints plots of the single event measure versus distance data (both only for the IPR>0 for the NP=0 option). The data computed and printed here are at the reference power setting and airspeed (L^{th} power setting).

The label 700 loop performs the following operations for each of the NP output power settings (PSC):

(1) Subroutine DELTA6 is called to compute the final profile data for all single event measures when IPR>0 and for each requested (MEAS>0) measure when IPR=0. The indices of the reference profile data required to interpolate or extrapolate these profile data are given in array IREQC which was evaluated in subroutine SETUPD6. These final profile data are stored in array PRDC. After all profile data are computed for the L^{th} power setting (end of loop 620), the LFLG program flag is checked. If LFLG is less than zero, no profile data were computed for this L^{th} power setting and the program skips down to the end of the 700 loop.

(2) For IPRR equal to one, subroutines OUTH and OUTJ are called to print and plot these final EPNLX through ALTX profile data. Note that whenever profile data are printed all seven measures are always computed.

(3) For IPU greater than zero, the requested (MEAS>0) EPNLX, ALX and SELX profile measures are written to the file on Unit 3 by subroutine PPFDAT. In the print node (IPR>0), these profile data are usually not written to Unit 3. A description of the format and content of these flight noise profile datasets is presented in Appendix F.

After completing the label 700 loop operations, subroutine SUMRY is called to print the final aircraft summary page which lists numerous test identification parameters, identifies all reference datasets read for this aircraft, and lists the COMDECK names of all reference datasets

required to interpolate or extrapolate each profile dataset. This summary page is always printed and is not controlled by the IPR print flag. Program control then returned to statement label 10 to perform the next aircraft analysis or to terminate the job. The OMEGA 10.8 job will terminate with a call to EXIT(1) if an error has occurred (ERRFLG = TRUE) or a call to EXIT(0) when the job terminates without an error (ERRFLG = FALSE).

SUBROUTINE ALPH(REL,TEMP,ABC)

This subroutine is called from the MAIN routine to compute the atmospheric absorption coefficients for non-standard output temperature (TEMP) and relative humidity (REL) for frequency bands 10 to 40. The coefficients for bands 10 to 16 are always zero. The coefficients for standard day conditions (59°F, 70 percent) are stored in the MAIN routine.

Subroutine Arguments

The subroutine arguments are defined as follows:

(1) REL and TEMP are the relative humidity and temperature (°F) for which the ABC data are computed.

(2) ABC is the absorption coefficient array defined in this subroutine

Data Statement Arrays

Array FREQ3 contains the geometric mean and lower limiting frequencies for 1/3 octave data. X and Y contain the normalized absolute humidity ($h_{normalized}$) and normalized molecular absorption coefficient ($\alpha_{normalized}$) data given in SAE ARP 866A.[2]

Atmospheric Absorption Coefficient Algorithm

The atmospheric absorption coefficients for 1/3 octave frequencies are computed as described below.

(1) The absolute humidity statement function is:

$$F(TEMP,REL) = \{(a)(REL)\}\{antilog[(b)(TEMP)+(c)(TEMP^2)+(d)(TEMP^3)]\}$$

where

$$a = 1.064764 \times 10^{-2}$$

$$b = 2.288074 \times 10^{-2}$$

$$c = -9.589 \times 10^{-5}$$

$$d = 3.0 \times 10^{-7}$$

(2) The normalized absolute humidity ($h_{normalized}$) is computed as a function of frequency.

$$HN = \frac{F(TEMP, REL)}{\left(\frac{FREQ}{1010}\right)^{1/2}}$$

where

FREQ = the geometric mean or lower limiting frequency for the 1/3 octave frequency.

(3) A quadratic Aitkin interpolation function is used to compute the normalized molecular absorption coefficient (ALN) for a given normalized absolute humidity (HN).

(4) Then the atmospheric absorption coefficient (ABC) as a function of frequency is:

$$ABC = (FREQ)(FT1)(ALN)+(FT2)(FREQ)^{2.05} \qquad dB$$

where

FT1	$= (3.788785 \times 10^{-3})(\text{antilog}[4.6833333 \times 10^{-3} \times TEMP])$
FT2	$= (2.4931591 \times 10^{-8})(\text{antilog}[6.33 \times 10^{-4} \times TEMP])$
(FREQ)(FT1)	= maximum molecular absorption coefficient.
$(FT2)(FREQ)^{2.05}$	= classical absorption coefficient.

FUNCTION ATKN(X,Y,N,K,XI)

This function is a general AITKEN interpolation function, used by subroutine ALPH to compute the normalized molecular absorption coefficient. ATKN was obtained from the ASD computer center library (old IBM 7094 library). Since this is a common interpolation function defined in most numerical methods texts, no additional description will be given. The function arguments are defined in comment statements in the listing.

FUNCTION ICV(R)

This function is used in numerous routines to convert variable DR from floating point to integer. The resulting integer is rounded up when the fractional part is greater than or equal to 0.5. This method gives more consistent and conservative noise measure data than would be obtained by simple truncation. In this PC version of OMEGA 10, ICV is set equal to the NINT function. Function ICV could be replaced by NINT everywhere in the program.

SUBROUTINE HEAD(IP)

This subroutine is called from subroutine OUTH to print the header block on output Pages H, I, L and M. The IP subroutine argument identifies the page for which the header block is requested. These header blocks are 108 columns wide (printer columns 11 to 119). Each header block contains the five categories of data information described below:

(1) The identification block located in the upper right corner identifies the specific OMEGA program, the aircraft code, the operation type and power codes (OPS), the profile version code, the date of the computer run, and the page number of that particular computer printout. These identification data enable the AL/OEBN to locate and track specific results in our data bank and reconstruct the source of the data and all processing parameters and computations.

(2) The table title printed across the top describe the measures or type of data presented on that page.

(3) The aircraft block identifies the specific aircraft (e.g., C-141).

(4) The operation block presents the operation power description, the power setting, and the airspeed.

(5) The meteorology block gives the temperature (°F), relative humidity (percent), and Delta N (dB). Note that Delta N is not a meteorology related constant.

SUBROUTINE IPA

This subroutine is called from the MAIN routine to initialize the ORD, PD, PB, and PM arrays used to print the tab plots in subroutines OUTG and OUTJ. The content of these arrays is obvious in the coding.

SUBROUTINE OUTG(DRAG,SOURCE)

This subroutine is called from the MAIN routine to print the plot and listing of the reference SPL spectrum versus 1/3-octave frequency for the L^{th} power setting. The PNLA, PNLTA, AL, ALTA, and C data computed from this mean spectrum and THETA, EPNLA, SELA and SELTA from the reference dataset as well as various operation and identification parameters are also printed below the plot.

Method

The integer SPL data are computed and stored in array ISRC. The maximum annotated abscissa scale value (MX) is the nearest multiple of ten less than seven plus the maximum SPL. The minimum scale value (MN) is 70 dB less than MX. The abscissa scale is defined in array ISC. The actual plotted maximum and minimum are two greater than MX and two less than MN.

The SPL data are scaled, set up in the print array (PP), and printed in the label 150 loop. The remainder of the subroutine completes the plot and prints the PNLA, PNLTA, etc. data below the plot. The detailed format of these Page G data can best be observed by consulting the sample problem in Appendix C. There should be sufficient comment statements in the subroutine listing to identify the data being printed.

SUBROUTINE CDIST(IRD,RV)

This subroutine is called from the MAIN routine to compute the single event noise profile data (e.g., SELX versus distance for 22 distances from 200 to 25,000 feet) for air-to-ground (IPROP=l) or ground-to-ground (IPROP=2) propagation for the L^{th} reference power setting. These data are also adjusted to the output temperature and relative humidity and to the program reference (RV) airspeed.

The subroutine argument IRD is the index of the standard distance which is within one percent of the reference distance. IRD is determined in this subroutine and returned to the MAIN routine.

The EA data statement array contains the excess attenuation data for frequency bands 17 through 40 and distances 200 to 25000 feet. These data are presented in Table 3 which was taken from AAMRL-TR-84-017.(3) This table also contains the data for bands 10 through 16 which are the same as for band 17. They are required to compute the ground-to-ground propagation data.

The flowchart in Figure 3 provides a brief description of the data computed by this subroutine.

Extrapolated SPL Spectra

The first segment of this subroutine (label 30 loop) extrapolates the reference SPL spectrum to each of the 22 profile distances defined in array SX. These 22 SPL spectra are used to compute the single event profile data for air-to-ground propagation. The extrapolation algorithm is:

TABLE 3

EXCESS SOUND ATTENUATION MODEL USED IN THE OMEGA 10 AND OMEGA 11 PROGRAMS (in dB)

Distance in Feet

Band No.	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	12500	16000	20000	25000
10	.0	.0	.25	.93	.72	.45	.12	-.25	-.66	-1.16	-1.60	-1.99	-2.20	-2.10	-1.65	-1.27	-1.27	-1.27	-1.27	-1.27	-1.27	-1.27
11	.0	.0	.25	.93	.72	.45	.12	-.25	-.66	-1.16	-1.60	-1.99	-2.20	-2.10	-1.65	-1.27	-1.27	-1.27	-1.27	-1.27	-1.27	-1.27
12	.0	.0	.25	.93	.72	.45	.12	-.25	-.66	-1.16	-1.60	-1.99	-2.20	-2.10	-1.65	-1.27	-1.27	-1.27	-1.27	-1.27	-1.27	-1.27
13	.0	.0	.25	.93	.72	.45	.12	-.25	-.66	-1.16	-1.60	-1.99	-2.20	-2.10	-1.65	-1.27	-1.27	-1.27	-1.27	-1.27	-1.27	-1.27
14	.0	.0	.25	.93	.72	.45	.12	-.25	-.66	-1.16	-1.60	-1.99	-2.20	-2.10	-1.65	-1.27	-1.27	-1.27	-1.27	-1.27	-1.27	-1.27
15	.0	.0	.25	.93	.72	.45	.12	-.25	-.66	-1.16	-1.60	-1.99	-2.20	-2.10	-1.65	-1.27	-1.27	-1.27	-1.27	-1.27	-1.27	-1.27
16	.0	.0	.25	.93	.72	.45	.12	-.25	-.66	-1.16	-1.60	-1.99	-2.20	-2.10	-1.65	-1.27	-1.27	-1.27	-1.27	-1.27	-1.27	-1.27
17	.0	.0	.25	.93	.72	.45	.12	-.25	-.66	-1.16	-1.60	-1.99	-2.20	-2.10	-1.65	-1.27	-1.27	-1.27	-1.27	-1.27	-1.27	-1.27
18	.0	.0	1.00	1.41	1.19	.90	.54	.15	-.29	-.81	-1.25	-1.57	-1.61	-1.13	-.08	.98	.98	.98	.98	.98	.98	.98
19	.0	.0	.25	.44	.26	.05	-.20	-.46	-.72	-.98	-1.11	-1.03	-.56	.53	2.15	3.79	3.79	3.79	3.79	3.79	3.79	3.79
20	.0	.0	.50	1.53	1.36	1.17	1.01	.89	.86	1.01	1.41	2.15	3.34	5.02	6.75	8.05	8.05	8.05	8.05	8.05	8.05	8.05
21	.0	.0	.75	2.16	2.29	2.49	2.79	3.21	3.83	5.13	5.99	7.54	9.47	11.55	13.00	13.12	13.12	13.12	13.12	13.12	13.12	13.12
22	.0	.0	1.00	2.29	3.50	4.97	6.71	8.53	10.48	12.67	14.57	16.22	17.55	18.51	19.13	19.13	19.13	19.13	19.13	19.13	19.13	19.13
23	.0	.0	1.60	4.44	6.85	9.69	12.93	16.10	19.20	22.19	24.10	24.90	24.45	23.22	22.76	22.76	22.76	22.76	22.76	22.76	22.76	22.76
24	.0	.0	4.50	11.69	13.63	15.90	18.46	20.94	23.30	25.48	26.69	26.88	25.90	24.18	23.18	23.18	23.18	23.18	23.18	23.18	23.18	23.18
25	.0	.0	7.00	13.06	14.58	16.39	18.25	18.67	19.02	19.25	19.21	18.88	18.23	17.38	16.74	16.18	15.62	15.06	15.00	15.00	15.00	15.00
26	.0	.0	5.00	10.71	12.28	14.13	15.58	15.93	16.22	16.42	16.41	16.16	15.66	14.97	14.33	13.50	12.67	11.84	11.50	11.25	11.25	11.25
27	.0	.0	4.20	8.74	10.23	12.00	12.50	12.64	12.75	12.77	12.67	12.39	11.92	11.25	10.53	9.57	8.61	7.65	7.10	7.00	7.00	7.00
28	.0	.0	3.30	7.33	8.64	9.38	9.33	9.24	9.13	8.94	8.71	8.40	7.97	7.40	6.72	5.82	4.92	4.02	3.70	3.70	3.70	3.70
29	.0	.0	2.10	5.39	6.48	6.58	6.54	6.45	6.32	6.08	5.77	5.34	4.84	4.31	3.88	3.26	2.64	2.02	2.00	2.00	2.00	2.00
30	.0	.0	1.20	3.09	3.93	4.25	4.30	4.31	4.28	4.17	3.96	3.63	3.17	2.60	2.06	1.37	.68	-.01	-.25	-.25	-.25	-.25
31	.0	.0	.25	1.31	2.06	2.50	2.78	3.03	3.24	3.36	3.31	3.03	2.46	1.59	.65	-.36	-1.37	-2.38	-2.80	-3.00	-3.00	-3.00
32	.0	.0	.00	.16	.86	1.71	2.69	3.10	3.11	3.02	2.81	2.42	1.76	.76	-.48	-2.09	-3.70	-5.31	-5.80	-6.00	-6.00	-6.00
33	.0	.0	-.50	-1.58	-.94	-.15	.80	1.81	2.80	2.71	2.43	1.87	.91	-.57	-2.46	-4.35	-6.24	-8.13	-8.90	-8.90	-8.90	-8.90
34	.0	.0	-.75	-1.34	-.75	-.03	.84	1.75	2.71	2.57	2.39	2.01	1.37	-.39	-.87	-2.13	-3.39	-4.65	-4.70	-4.90	-4.90	-4.90
35	.0	.0	.00	.53	1.03	1.67	1.55	2.03	2.51	2.44	2.34	2.17	1.84	1.34	.71	.08	-.55	-1.18	-1.20	-1.30	-1.30	-1.30
36	.0	.0	.75	1.92	2.03	2.15	2.25	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
37	.0	.0	.75	1.92	2.03	2.15	2.25	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
38	.0	.0	.75	1.92	2.03	2.15	2.25	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
39	.0	.0	.75	1.92	2.03	2.15	2.25	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
40	.0	.0	.75	1.92	2.03	2.15	2.25	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30

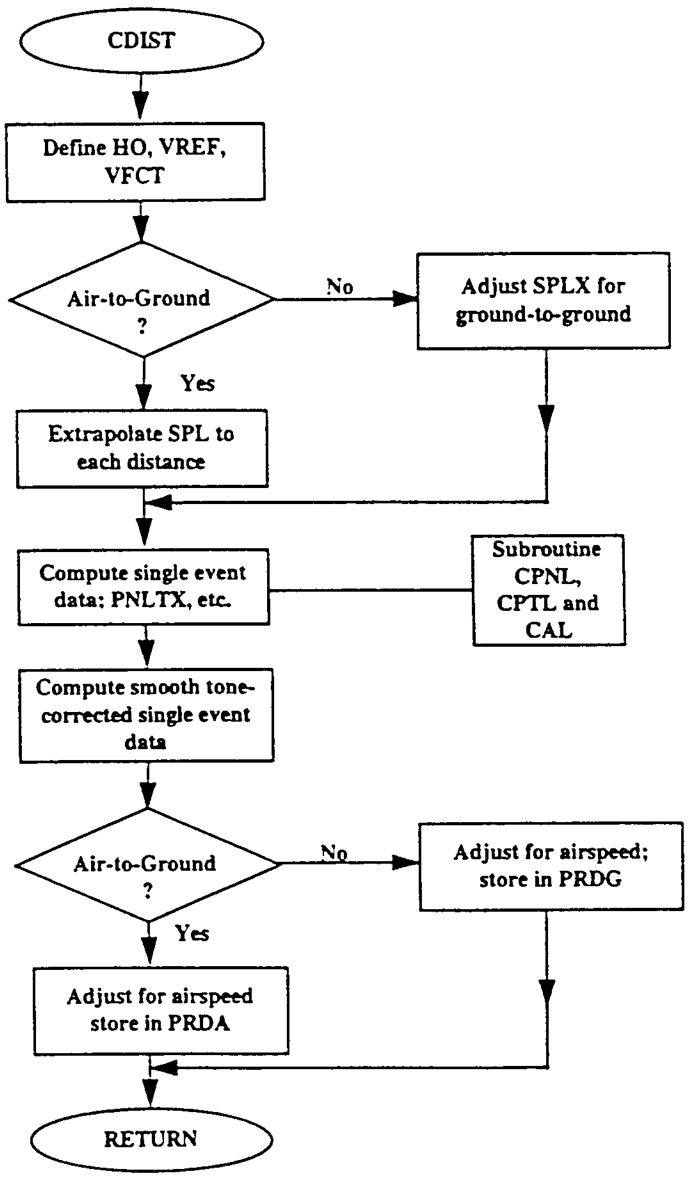


Figure 3. Flowchart for Subroutine CDIST.

$$SPLX_{I,J} = SPLA_{L,J} - \frac{(SX_I)(ATNC_J) - (H0)(ATNR_J)}{SNTH} - 20\log(SX_I / H0) + DELN \quad \text{dB}$$

where

$SPLX_{I,J}$	=	the sound pressure level in dB for the I^{th} distance and J^{th} band.
$SPLA_{L,J}$	=	the mean sound pressure level in dB for the L^{th} reference power setting and the J^{th} band.
SX_I	=	antilog $\left(\frac{I+22}{10}\right)$ which is the I^{th} profile distance in feet.
$ATNC_J$	=	the atmospheric absorption coefficients in dB per 1000 feet for the profile output temperature (ITEMP) and humidity (IRHUM).
$ATNR_J$	=	the atmospheric absorption coefficients in dB per 1000 feet for standard day conditions.
SNTH	=	(1000) (SIN [$THETA_L$]).
$THETA_L$	=	the directivity angle in degrees for the L^{th} power setting.
H0	=	the reference minimum slant range in feet for the L^{th} power setting.
DELN	=	the constant dB level added to all SPL bands for the L^{th} power setting.

The following distance function used later in this subroutine to adjust the integrated single event data for changes in slant range is also computed in this segment of the program:

$$D2X_I = 6 \log (SX_I/H0)$$

Adjust the SPL Spectra for Ground-to-Ground Propagation

The SPL spectra computed for air-to-ground propagation are adjusted for ground-to-ground propagation after all air-to-ground data are computed for the L^{th} reference power setting:

$$SPLX_{I,J} = SPLX_{I,J} - EA_{I,1}$$

where

I	=	the distance index defined for the 22 distances.
J	=	the frequency band index defined for frequency bands 10 through 16.
$EA_{I,1}$	=	excess attenuations in dB for the I^{th} distance and for frequency band 17.

$$SPLX_{I,J} = SPLX_{I,J} - EA_{I,J}$$

where I is defined for all 22 distances and J is defined for bands 17 through 40. The excess attenuation is constant for frequency bands less than 17 and greater than 36.

A constant ground-to-ground adjustment factor (DG) is also subtracted from the air-to-ground SPL for all distances and all frequency bands:

$$SPLX_{I,J} = SPLX_{I,J} - DG$$

This DG adjustment factor is currently 0 dB.

Single Event Noise Data

The statement label 150 loop computes all single event noise data for each of the profile distances. Subroutines CPNL, CPTC, and CAL are called to compute the perceived noise level (PNLX), tone correction (PTC) and the A-weighted overall sound level (ALX), respectively, for each distance spectrum. If PNLX data are missing for distances beyond the second distance, the PNLX data are extrapolated as follows:

$$PNLX_I = (2)\,(PNLX_{I-1}) - PNLX_{I-2} \qquad \text{PNdB}$$

The tone-corrected perceived noise level (PNLTX) and tone-corrected A-weighted overall sound level (ALTX) for the I^{th} distance are:

$$PNLTX_I = PNLX_I + PTC \qquad \text{PNdB}$$

$$ALTX_I = ALX_I + PTC \qquad \text{dBA}$$

The effective perceived noise level (EPNLX), sound exposure level (SELX), and tone-corrected sound exposure level (SELTX) are:

$$EPNLX_I = EPNLA_L + PNLTX_I - PNLTA_L + D2X_I \qquad \text{EPNdB}$$

$$SELX_I = SELA_L + ALX_I - ALA_L + D2X_I \qquad \text{dB}$$

$$SELTX_I = SELTA_L + ALTX_I - ALTA_L + D2X_I \qquad \text{dB}$$

where $EPNLA_L$, $SELA_L$, and $SELTA_L$ are the mean data from the reference dataset for the L^{th} power setting. The $PNLTA_L$, ALA_L, and $ALTA_L$ were computed from the reference SPL spectrum for the L^{th} power setting.

Smooth Tone-Corrected Data

The last segment of this subroutine (statement label 220 loop) computes the smoothed ALTX, PNLTX, SELTX, and EPNLX data for each distance (I) and adjusts these data to the program reference airspeed:

$ALTX_I$	=	$ALX_I + (C2)(D3)$	dBA
$PNLTX_I$	=	$PNLX_I + (C2)(D3)$	PNdB
$SELTX_I$	=	$SELX_I + (C1)(D3)$	dB
$EPNLX_I$	=	$EPNLX_I + (C1)(D3) - C3_I$	EPNdB

where

C1	=	$SELTX_{IRD} - SELX_{IRD}$	dB
C2	=	$ALTX_{IRD} - ALX_{IRD}$	dBA
IRD	=	the index of the reference distance	
$C3_I$	=	$SELTX_I - SELX_I$	dB
D3	=	1.0 for distances 200 to 3,150 feet	
D3	=	(0.2) (18-I) for distances 4,000 to 8,000 feet (I=14 to 17).	
D3	=	0.0 for distances 10,000 to 25,000 feet.	

The $SELTX_I$ used to compute $C3_I$ above is the unsmoothed $SELTX_I$ defined in the previous section; that is, $C3_I$ is the tone correction for the unsmoothed SELTX and EPNLX data.

All EPNLX, SELTX, and SELX data for the L^{th} reference power setting are adjusted to the program reference airspeed and stored in arrays PRDA or PRDG as required in subroutine DELTA6. The four remaining single event measures, PNLTX through ALX, are also stored in arrays PRDA and PRDG, but without the airspeed adjustment which does not apply to these nonintegrated measures. It should also be noted here that all seven measures are stored in blank common arrays PNLTX through SELX without the airspeed adjustment.

For air-to-ground propagation (IPROP=1):

$PRDA_{I,L,1}$	=	$EPNLX_I$ - VFCT	EPNdB
$PRDA_{I,L,2}$	=	$SELTX_I$ - VFCT	dB
$PRDA_{I,L,3}$	=	$SELX_I$ - VFCT	dB
$PRDA_{I,L,4}$	=	$PNLTX_I$	PNdB
$PRDA_{I,L,5}$	=	$PNLX_I$	PNdB

$PRDA_{I,L,6}$	=	$ALTX_I$	dBA
$PRDA_{I,L,7}$	=	ALX_I	dBA

and for ground-to-ground propagation (IPROP=2):

$PRDG_{I,L,1}$	=	$EPNLX_I$ - VFCT	EPNdB
$PRDG_{I,L,2}$	=	$SELTX_I$ - VFCT	dB
$PRDG_{I,L,3}$	=	$SELX_I$ - VFCT	dB
$PRDG_{I,L,4}$	=	$PNLTX_I$	PNdB
$PRDG_{I,L,5}$	=	$PNLX_I$	PNdB
$PRDG_{I,L,6}$	=	$ALTX_I$	dBA
$PRDG_{I,L,7}$	=	ALX_I	dBA

where VFCT adjusts the airspeed from the reference file airspeed for the L^{th} power setting (IV_L) to the program reference airspeed (RV) in knots:

$$VFCT = 10\log\left(\frac{RV}{IV_L}\right).$$

RV is currently defined as 250 knots in the main routine. These single event measure data, which were computed from the single event reference data and the reference SPL spectrum extrapolated to each of the 22 profile distances, are frequently identified as "reference file measure data" or "reference file profile data" in the remainder of this OMEGA 10 documentation.

SUBROUTINE CPNL(I,ID)

This subroutine is called from the MAIN routine and subroutine CDIST to compute the perceived noise level (PNL) for the I^{th} spectrum using the standard method described in several references.[4,5] The PNL quantifies the relative subjective noisiness of different sound spectra and is widely used to assess the annoyance of individual sounds.[6,7] The ID subroutine argument determines whether the PNL data are computed from the mean SPL spectrum for the I^{th} power setting ($SPLA_{I,J}$ for ID=0) or the extrapolated SPL spectrum for the I^{th} distance ($SPLX_{I,J}$ for ID=1).

Variables IL and IBNH are the indices of frequency bands 17 and 40 (frequencies 50 to 10,000 Hz) as required by the PNL algorithm. FJ is a PNL weighting factor defined for the 1/3 octave band data.

Method

PNL is calculated as follows from each 1/3 octave band SPL spectrum (I):

(1) Convert each 1/3 octave band SPL (array SPLA or SPLX) for frequency band indices IL to IBNH to perceived noisiness FN_J using function FNOY which defines the noisiness of sound in noy units as a function of frequency and SPL. Also sum these noy values (SUM) and determine the largest value (AMX).

(2) Determine the total perceived noisiness, SUM, as follows:

$$SUM = (FJ)[\sum_J (FN_J) - AMX] + AMX \qquad \text{noys}$$

where FJ = 0.15 for 1/3 octave band data.

FN_J = perceived noisiness value for frequency index J from Step (1).

AMX = number of noys in the noisiest band.

(3) Calculate PNL:

$$PNL = 40+33.3 \log (SUM) \qquad \text{PNdB}$$

When one or more SPL data points are beyond the range of the noy algorithm, PNL is set equal to 9999.

FUNCTION FNOY(SPL,JJ)

This function is used by subroutine CPNL to compute the perceived noisiness value (in noys) for a given 1/3 octave band sound pressure level (SPL) using the method described in SAE ARP 865A.[5] Function argument JJ is the frequency band index (numeric value of 1 to 24) corresponding to the 24 frequency bands from 50 to 10,000 Hz and used in data statement arrays FL and FM.

Method

The perceived noisiness value FNOY, in noys, for a particular frequency band (JJ) is related to the band sound pressure level, SPL, by the following equations:

(1) For $FL_{JJ,1} \leq SPL < FL_{JJ,2}$

$$FNOY = 0.1 \text{ antilog } [(FM_{JJ,1})(SPL - FL_{JJ,1})] \qquad \text{noys}$$

(2) For $FL_{JJ,2} \leq SPL < FL_{JJ,3}$

$FNOY = \text{antilog}\ [(FM_{JJ,2})(SPL - FL_{JJ,3})]$ noys

(3) For $FL_{JJ,3} \leq SPL < FL_{JJ,4}$

$FNOY = \text{antilog}\ [(FM_{JJ,3})(SPL - FL_{JJ,3})]$ noys

(4) For $FL_{JJ,4} \leq SPL < 150$

$FNOY = \text{antilog}\ [(FM_{JJ,4})(SPL - FL_{JJ,5})]$ noys

(5) For $SPL < FL_{JJ,1}$

$FNOY = 0.0$ noys

(6) For SPL > 150, FNOY is undefined because it is beyond the range of the perceived noisiness algorithm (carried as 5001).

Data statement arrays FL(24,5) and FM(24,4) contain the L_1 to L_4 and M_1 to M_4 versus frequency data listed in Table 4 (from SAE ARP 865A[5]).

SUBROUTINE CPTC(PTC,I,ID)

This subroutine is called from the MAIN routine and from subroutine CDIST to compute the tone correction (PTC) for the I^{th} spectrum. This I^{th} spectrum will be from array $SPLA_{I,J}$ for the I^{th} power setting when the ID subroutine argument is zero (CPTC called from MAIN) or from array $SPLX_{I,J}$ for the I^{th} distance for ID=1 (CPTC called from CDIST). The blank common array $IPTC_I$ is used to store the frequency index (J) of the frequency band which determined the tone correction for the I^{th} spectrum.

This subroutine uses the procedure described in FAR Part 36, Section 36.3.[4] This procedure requires SPL data for 1/3 octave frequency bands 80 to 10,000 Hz; however, this subroutine will compute PTC when SPL data greater than or equal to 20 dB are available for at least 10 consecutive bands within this 1/3 octave frequency band range (only SPL data greater than or equal to 20 dB are used).

Method

Before applying the tone correction procedure, this subroutine determine the largest SPL data point in the spectrum and also the number of consecutive SPL data points greater than 20 dB on each side of this peak value (statement labels 370 to 490). If the total number of points is less than ten, tone correction is undefined (9999) and control is returned to the calling routine. When

TABLE 4

DATA STORED IN ARRAYS FL(24,5) AND FM(24,4) IN FUNCTION FNOY[5]

Band Center Frequency (Hz)	L_1*	M_1**	L_2	M_2	L_3	M_3	L_c	M_4	L_4
50	49	0.079520	55	0.058098	64	0.043478	91.01	0.030103	52
63	44	0.068160	51	0.058098	60	0.040570	85.88	0.030103	51
80	39	0.068160	46	0.052288	56	0.036831	87.32	0.030103	49
100	34	0.059640	42	0.047534	53	0.036831	79.85	0.030103	47
125	30	0.053013	39	0.043573	51	0.035336	79.76	0.030103	46
160	27	0.053013	36	0.043573	48	0.033333	75.96	0.030103	45
200	24	0.053013	33	0.040221	46	0.033333	73.96	0.030103	43
250	21	0.053013	30	0.037349	44	0.032051	74.91	0.030103	42
315	18	0.053013	27	0.034859	42	0.030675	94.63	0.030103	41
400	16	0.053013	25	0.034859	40	0.030103	100.00	0.030103	40
500	16	0.053013	25	0.034859	40	0.030103	100.00	0.030103	40
630	16	0.053013	25	0.034859	40	0.030103	100.00	0.030103	40
800	16	0.053013	25	0.034859	40	0.030103	100.00	0.030103	40
1000	16	0.053013	25	0.034859	40	0.030103	100.00	0.030103	40
1250	15	0.059640	23	0.034859	38	0.030103	100.00	0.030103	38
1600	12	0.053013	21	0.040221	34	0.029960	100.00	0.029960	34
2000	9	0.053013	18	0.037349	32	0.029960	100.00	0.029960	32
2500	5	0.047712	15	0.034859	30	0.029960	100.00	0.029960	30
3150	4	0.047712	14	0.034859	29	0.029960	100.00	0.029960	29
4000	5	0.053013	14	0.034859	29	0.029960	100.00	0.029960	29
5000	6	0.053013	15	0.034859	30	0.029960	100.00	0.029960	30
6300	10	0.068160	17	0.037349	31	0.029960	100.00	0.029960	31
8000	17	0.079520	23	0.037349	37	0.042285	44.29	0.029960	34
10000	21	0.0596401	29	0.043573	41	0.042285	50.72	0.029960	37

*L_1 to L_4 data are stored in FL(24,5).

**M_1 to M_4 data are stored in FM(24,4).

at least ten points are available, the tone correction procedure is applied over redefined frequency band indices IL2 to IH1.

The remainder of this subroutine (statement labels 5 to 220) is a direct application with one exception of the ten step tone correction procedure defined in FAR Part 36, Section 36.3. This exception to Far Part 36 is explained in item (4) below. The final tone correction is returned in variable PTC. The following comments compare the notation used in the coding and in the FAR Part 36 description:

(1) The frequency band index i in Part 36 corresponds to J in the coding. Spectrum index K doesn't apply because the subroutine operates on one spectrum per call.

(2) Circled SPL data are denoted by variable ICT_J equal to one.

(3) All other variable correspondence should be obvious.

(4) The direct application of Far Part 36, Section 36.3 to compute tone correction will occasionally result in a false tone at a frequency greater than 2500 Hz. The if statement at label 110 was added to check two SPL slopes at the F_J frequency. This check eliminates most of the false tones at high frequencies.

SUBROUTINE CAL(I,ID)

This subroutine is called from the MAIN routine and from subroutine CDIST to compute the A-weighting overall sound level (AL) for the I^{th} spectrum. The subroutine argument ID determines whether the AL data are computed from the mean SPL spectrum for the I^{th} power setting or the extrapolated SPL spectrum for the I^{th} distance. ID is defined the same as in subroutines CPTC and CPNL.

<u>Method</u>

AL is defined as follows:

$$AL_I = 10\log[\sum_J \text{antilog}\left(\frac{SPL_{I,J} + AW_J}{10}\right)] \qquad \text{dBA}$$

where

J = the frequency band index; J is defined for bands 10 to 40 (indices 1 to 31).

$SPL_{I,J}$ = the sound pressure level for the I^{th} spectrum or I^{th} distance and the J^{th} band (arrays SPLX or SPLA).

AW_J = the A-weighting relative response in dB for the J^{th} band (see Table 5).

TABLE 5
WEIGHTING FACTORS

Frequency (Hz)	Relative Response (dB) A-Weighting
10	- 70.4
12.5	- 63.4
16	- 56.7
20	- 50.5
25	- 44.7
31.5	- 39.4
40	- 34.6
50	- 30.2
63	- 26.2
80	- 22.5
100	- 19.1
125	- 16.1
160	- 13.4
200	- 10.9
250	- 8.6
315	- 6.6
400	- 4.8
500	- 3.2
630	- 1.9
800	- 0.8
1000	0
1250	0.6
1600	1.0
2000	1.2
2500	1.3
3150	1.2
4000	1.0
5000	0.5
6300	- 0.1
8000	- 1.1
10000	- 2.5

If the AL data are undefined for the I^{th} spectrum, AL is set equal to 9999; this should never occur in this program.

SUBROUTINE OUTH(IRD,IPTC,SENX,LFLG,IPF)

This subroutine is called from the MAIN routine to print the SPL spectra versus slant distance on Pages H and L and/or the single event noise data (seven measures) versus slant distances on Pages I and M. The air-to-ground data (IPROP=1) are printed on Pages H and I and the ground-to-ground data (IPROP=2) on Pages L and M. Subroutine argument IRD is the index of the profile distance which is within one percent of the reference distance for this power setting. The remaining arguments are defined in subroutine comment statements. The data format and page layout for each page can best be determined by consulting the sample problem in Appendix C.

Print SPL Spectra

The first segment of this subroutine which is omitted when IPF>2 prints the SPL spectra versus distance data for the 22 profile distances. Subroutine HEAD is called to print the page header block. The statement label 50 loop sets up the integer and variable format arrays and prints each of the 22 spectra. All SPL data less than zero are omitted from the printout (blanked out). The frequency band which determines the tone correction in the reference distance spectrum is flagged with the ">" symbol. The variable format is required to accommodate the blank and flagged data.

Print Single Event Data

The remainder of this subroutine (from label 50) prints the single event versus distance data for the 22 profile distances. The sequence of these seven single event measures in array SENX is determined by the IPF program flag. For IPF≤2, the sequence is PNLTX, PNLX, ALTX, ALX, EPNLX, SELTX and SELX; while for IPF>2, the sequence is EPNLX, SELTX, SELX, PNLTX, PNLX, ALTX and ALX. Neither sequence is the same as the print sequence which is just the reverse of the latter case (IPF>2). Thus, index variable JD is setup to identify the single event data in array SENX in the required print sequence. For the IPF>2 case, variable JD is defined by the ISEQD data statement array which contains the indices of these single event measures in the print sequence. These data are first written to the DM character array to blank out all negative single event data. This character array is then printed with format statement 2700.

At label 55 subroutine HEAD is called to print the Page I or M header block. The label 100 loop prints the measure data for each distance. The label 80 loop sets up the variable print array for each measure for the I^{th} distance.

SUBROUTINE OUTJ(IP,SENX,LFLG)

This subroutine is called from the MAIN routine to print the single event measure printer plots for air-to-ground (IPROP=l, Pages J and K) or ground-to-ground (IPROP=2, Pages N and O) data for the L^{th} power setting. The value of the subroutine argument IP determines the single event measures plotted on each page. When IP is one or four, the PNLTX, PNLX, ALTX, and ALX data are plotted on Pages J or N, and when IP is two or three, the EPNLX, SELTX, and SELX data are plotted on Pages K and O. This IP program flag also determines the sequence in which these single event data are stored in array SENX. This data sequence is described in detail in subroutine OUTH where program flag IPF is equivalent to IP in this routine. Subroutine argument LFLG is a footnote flag; for LFLG=1, an extrapolation limit flag is printed at the bottom of each page. The plot format and page layout can best be determined by consulting the sample problem in Appendix C.

Method

Each printer plot contains the distance scale on the ordinate and the dB scale on the abscissa. The distance scale always contains the same 22 profile distances from 200 to 25,000 feet. The abscissa scale is 8.3 inches wide and covers an 83 dB range. The maximum abscissa scale value is determined from the measure data for the first ten distances (smallest distances). The maximum annotated scale value is the largest multiple of ten which is less than the largest measure plus eight. The largest plotted point may be one larger than this multiple of ten. All data outside the abscissa scale range are deleted from the plot.

The label 400 loop sets up the plot array and the grid pattern for each profile distance. An identification block is printed in the upper left corner and a legend block is printed in the lower right corner of the grid. These blocks do not normally interfere with the plotted data points; however, they do make the coding more complex and thus more difficult to change.

The label 150 loop scales the three or four (Jl to J2) data points plotted for each distance, sets up the scaled point in the plot array with the correct symbol, and saves the data presently in the plot array. There should be sufficient comment statements in this subroutine to follow the data being printed; thus no additional documentation will be given here.

SUBROUTINE PPFDAT(PRDC,LFLG,COMD)

This subroutine is called from the MAIN routine to write the profile datasets on Unit 3 for the L^{th} output power setting (PSC). The air-to-ground and ground-to-ground data are in array PRDC. LFLG is a program flag which when equal to one adds an additional extrapolation limit comment line to each profile dataset. The format and content of these profile datasets is given in Appendix F. There should be sufficient comment statements in this subroutine to follow the data being written.

SUBROUTINE TITPG(IPR)

This subroutine is called from the MAIN routine to print the aircraft title page which identifies the aircraft being analyzed and the data computed in the analysis. The format and content of this page can best be determined by consulting the sample problem in Appendix C. There should be sufficient comment statements in the coding to follow the information being printed. IPR is the program print flag.

SUBROUTINE SETUPD6(IREQ,N,NP,TYPE)

This subroutine is called from the MAIN routine to apply the interpolation/extrapolation rules to determine the reference data required to compute the profile data at the requested output power setting (PSC). The indices of these reference data required for each PSC are stored in array IREQC and used in subroutine DELTA6. The IREQ, N, and NP subroutine arguments and numerous additional variables are defined in the comment statements at the beginning of this subroutine. Argument TYPE is a character array used to store the interpolation code (I, N or P) for each dataset reference.

In the OMEGA 10 version 7 update in May 1991, the method used to interpolate noise measure data at non reference power conditions was changed. Formerly a complex set of rules based on the operation power code (OPC) was used to setup the interpolation equation. These rules were abandoned and each reference dataset was assigned an interpolation code which is used to setup the power setting interpolation equation. These interpolation codes were assigned to each reference dataset after reviewing all the available data for a specific aircraft. The code is stored as the last character in the COMDECK name and replaces the COMDECK revision code in the flight reference data COMDECK name in NOISEFILE.

The three interpolation codes currently used in NOISEFILE and OMEGA 10 are I, P and N. Datasets coded as I for a specific aircraft are used to define a power setting versus noise level

point to point linear interpolation function which is used to interpolate noise level for an output power setting whose reference OPCR is coded as I and whose power setting is not the same as any of the reference file power settings. The P interpolation code stands for parallel interpolation and the N interpolation code stands for no interpolation. Parallel interpolation means that the data coded as P are interpolated along a slope line determined by the point to point I interpolation function but with the slope line offset so it passes through the reference power versus noise level point (OPCR). Output power settings requested using an OPCR with type code N must match the reference power setting since no power interpolation is permitted.

Method

The OMEGA 10 setup file (code sheet input) may contain up to twelve output power settings (PSC) for each aircraft set. Each of these PSC's must have a reference operation power code (OPCR) identified in the setup file. This OPCR must be in the reference dataset file or data for the PSC are omitted from the computer job. This OPCR determines the operation power description assigned to the corresponding PSC as well as the type of interpolation (I, N or P) used to compute the profile data. A brief overview of the interpolation procedure is described as follows:

(1) If the OPCR identifies the PSC as type I, then this subroutine identifies the two type I reference datasets with power settings which bracket the given PSC. The PSC may be interpolated anywhere along the type I power versus noise level function. PSC extrapolations beyond the high or low end points use the last two type I reference data points and are limited to 5 dB beyond the end point.

(2) If the OPCR identifies the PSC as type P, then this subroutine identifies the two type I reference datasets with power settings which bracket the reference power setting identified by the OPCR. This pair of type I reference points are used to determine the slope line which is offset to pass through the OPCR noise versus power setting point. If the given PSC also falls within the power setting range of these two type I reference points, the noise level for this PSC is interpolated along the slope line which is offset to pass through the OPCR point. If the PSC power setting is outside the reference points which bracket the OPCR, then the noise level offset between the OPCR and this slope line is computed and applied to a second slope line determined by a pair of type I reference points which bracket the given PSC power setting. This pair of type I reference points which bracket the given PSC may be anywhere along the reference power versus noise level function; however, the extrapolation from the

noise level at the reference power setting (OPCR) and at the reference distance is limited to 5 dB.

(3) If the OPCR identifies the PSC as type N, then this PSC must exactly match the power setting (PS) for the OPC identified by this OPCR. If PS is not the same as PSC, this PSC is omitted from the OMEGA 10 job and an error message is printed.

This subroutine identifies the reference file OPC power settings required to interpolate the output noise profiles for each output PSC. The interpolation is done later in subroutine DELTA6. Array IREQ(15) is used as a flag to identify the reference datasets which are used to compute at least one PSC. If $IREQ_J$ is greater than zero, this J^{th} reference file OPC is required and all reference profile data must be computed. Array IREQC(7,15) is used to store the indices of the reference OPC's required to compute the profile data for each output PSC. A brief description of this IREQC array is as follows.

(1) If $IREQC_{I,J}$ is zero for I equal one to three, then no profile data are computed for this J^{th} PSC.

(2) If $IREQC_{3,J}$ is zero and $IREQC_{1,J}$ is greater than zero, then no interpolation is required and $IREQC_{1,J}$ contains the reference file index of the required profile data.

(3) For a typical interpolation where there are two slope end points and the reference point from which the interpolation is computed, the indices of the two slope points are stored in $IREQC_{1,J}$ and $IREQC_{2,J}$ and the reference point is stored in $IREQC_{3,J}$. This $IREQC_{3,J}$ index will be negative when the 5 dB interpolation limit must be checked at the reference distance. For type I interpolation, index $IREQC_{3,J}$ will usually be the same as either the $IREQC_{1,J}$ or $IREQC_{2,J}$ index. For type P interpolation, the three indices will usually be different since the type P reference point is usually offset from the type I slope line.

(4) For a type P interpolation which requires two slope lines, the first slope line is used to determine the noise level offset between the OPCR point and the type I interpolation slope line at the OPCR power setting. The second slope line end points bracket the output PSC for this OPCR; this slope line is used to interpolate the noise levels at this PSC power setting. The offset from the first slope line is added to the interpolated levels. In this subroutine the indices of the first slope line end points are stored in $IREQC_{4,J}$ and $IREQC_{5,J}$. The index of the OPCR reference point is in $IREQC_{6,J}$. The corresponding indices for the second slope line

are saved in $IREQC_{1,J}$ through $IREQC_{3,J}$. The $IREQC_{3,J}$ and $IREQC_{6,J}$ reference point indices are multiplied by minus one when the extrapolation limit must be checked in subroutine DELTA6. The $IREQC_{7,J}$ or seventh array element is used to store the index of a type I reference power setting which is between the two pairs of slope end points. This fifth type I point is not used to compute either slope line; it is used in the interpolation procedure in subroutine DELTA6. (Note that as of February 10, 1993 no NOISEFILE reference data has five type I points with one or more type P points. Thus $IREQC_{7,J}$ will always be zero.)

In this subroutine the loops labeled 15 and 20 use internal read statements to convert reference (PS) and output (PSC) power setting values from character to real. The real arrays are PSIF and PSCF, respectively.

From label 30 to label 90 the indices of the KK type N and type P reference data are stored in the first KK elements of array NRI. The type I data are then ranked by increasing power setting starting with rank KK+1. The index of the type I data of rank K is stored in the K^{th} element of array NRI.

The label 400 loop sets up arrays IREQ and IREQC for each of the NP output power settings (PSCF). The indices setup in IREQC are used in subroutine DELTA6 to interpolate the output profile data. The label 95 loop identifies the index (J) of the reference operation power code (OPC) which matches the operation power code (OPCR) assigned to the output power setting. Variable "J" will be used to store this index throughout the label 400 loop. The next section of code from label 100 to label 105 checks for type N and type P interpolation and also checks the input (PSIF) and output (PSCF) power settings to determine if they are the same in which case no interpolation is required.

The label 110 loop determines the type I power setting indices which bracket the output power setting for type I or bracket the input power setting for type P data. The first three elements of IREQC are set in this loop. The next section of code starting at label 115 checks the type P data to determine if a second slope line in required. When a second slope line is required for type P, elements four to six of IREQC are set equal to the indices which bracket the reference PSIF power setting and a second pass through the label 110 loop defines the bracketing indices around the output PSCF power setting.

The section of code containing the label 220 loop is executed only for type P interpolation where two slope lines are required. The type I power setting points are checked to determine if there is an unused type I power setting value between the two slope lines. If this is

the case, the index of this point is saved in element seven of IREQC. This index will be needed in subroutine DELTA6 only if the extrapolation limit is exceeded using the second slope line for this type P interpolation.

The section of code from labels 370 to 395 prints error messages to the list file and sets ERRFLG to TRUE. The label 500 to 510 code is executed when the NP equal zero option is selected. For NP equal zero, profile data are computed for all reference file power settings at the reference file conditions for the selected aircraft. The first N elements of IREQ are set to one and the first element of IREQC for each of the N power settings is set equal to the index of that power setting.

SUBROUTINE DELTA6(PRDI,PRDC,K,PSIF,PSCF,IREQC,LFLG,VFCT,LIM,EXTMX)

This subroutine is called from the MAIN routine to apply the interpolation algorithms in computing the final flight noise PNLX, PNLTX, ALX, ALTX, SELX, SELTX and EPNLX profile data at the requested power setting (PSC) and airspeed. All the subroutine arguments are defined in the comment section at the beginning of this subroutine (source listing). The term "reference file measure data" used in the following paragraphs is the measure data (PNLX, etc.) derived from the SPL reference spectrum after it is extrapolated to each of the 22 profile distances (see subroutine CDIST).

Method

The following linear interpolation (or extrapolation) function (F) is defined in this subroutine and used to compute the single event noise measures at each profile distance:

$$YC=\left(\frac{Y2-Y1}{X2-X1}\right)(XC-XB)+YB$$

where

YC	=	the interpolated or extrapolated measure data for the PSC power setting (array PRDC);
Y1 and Y2	=	the reference file measure data used to compute the slope (array PRDI);
YB	=	the reference file measure data reference point defined by OPCR (array PRDI);
X1 and X2	=	the reference file power setting data used to compute the slope (array PSIF);
XC	=	the requested power setting (array PSCF); and
XB	=	the reference file power setting defined by OPCR (array PSIF).

The airspeed adjustment factor (VFCT) is subtracted from this YC data where

$$VFCT = 10\log\left(\frac{VX_L}{RV}\right)$$

VX_L = profile output airspeed (knots) for L^{th} PSC.

RV = program reference airspeed (presently 250 knots).

Note that VFCT is always zero for all PNLX, PNLTX, ALX and ALTX data since the airspeed adjustment only applies to the integrated measures.

The linear interpolation algorithm used to compute the limiting power setting when the noise level extrapolation limit (EXTMX) is exceeded is:

$$XC = XB + \left(\frac{YL - YB}{Y2 - Y1}\right)(X2 - X1)$$

where

XC = the new PSC power setting (PSCF) corresponding to the limiting measure value (YL); and

YL = the limiting measure value (YL=YB±EXTMX), YL is EXT in the program.

All other variables are defined for the YC equation above.

Array IREQC is defined in detail in the comments at the beginning of this subroutine as well as in the subroutine SETUPD6 documentation. The interpolation procedure is also described in detail in subroutine SETUPD6. With this background there should be sufficient comment statements in the source listing to follow the coding; however, the following outline of this subroutine may be helpful. The principle segments of this subroutine are:

(1) The statement label 40 loop uses the slope and reference points to interpolate the measure data and apply the airspeed adjustment. This is a direct application of the above YC equation.

(2) The label 50 loop is used to compute the type P interpolation where two slope lines are required. First the noise measure offset is computed at the reference $PSIF_{K6}$ power setting. Next the interpolated noise measure data are computed at the output PSCF power setting.

(3) The label 80 loop applies the airspeed adjustment to the given reference file noise measure data. For these data the reference and output power settings are the same and no interpolation is required.

(4) The segment of code in the IF statement following label 150 checks the extrapolation limit for type P interpolation where two slopes are required. This limit is checked only at the 1000 foot reference distance and only for one noise measure. If the computed noise measure exceeds the extrapolation limit at the low end, program execution is transferred to label 180 where a new output power setting is determined for this minimum noise measure level. If the limit is exceeded at the high end, program execution is transferred to label 182 to compute the new power setting at the upper limit.

(5) The next section of code starting at label 153 checks the extrapolation limits for the single slope type I or type P extrapolations. If a limit is exceeded, a new output PSCF power setting is computed at label 170.

(6) The segments of code following labels 180 and 182 compute new limiting output power settings for cases where the computed noise measure was below the lower limit or above the upper limit, respectively. In each segment the new PSCF is checked and the appropriate slope indices are assigned. The PSCF is recomputed as needed when the slope line changes.

(7) The label 185 segment is executed when the PSCF computed in one of the previous sections (labels 180 and 182) falls within the first slope PSIF range. This eliminated the need for the second slope line. The PSCF is recomputed using the first slope reference points and the IREQC indices are redefined.

(8) The final segment of code starting at label 180 sets the extrapolation limit flag LFLG to indicate that the output power setting was recomputed. This code also formats the computed PSCF into the PSC character array. Program execution is returned to label 25 where the profile data are computed.

Note that all code after label 150 deals with checking the extrapolation limits and recomputing a new PSCF where the limit is exceeded.

SUBROUTINE SUMRY(IPU,COMD,EXTMX,N,NP,SOURCE,LFLG)

This subroutine is called from the MAIN routine at the end of each aircraft analysis to print a summary of the input and output data for that aircraft. The subroutine arguments are:

(1) IPU is the profile dataset print (on Unit 3) flag;

(2) COMD contains the last 5 characters of the reference dataset comdeck name;

(3) EXTMX is the maximum extrapolation permitted by the program (see subroutine DELTA6);

(4) N is the number of input power settings (PS);

(5) NP is the number of output power settings (PSC);

(6) SOURCE contains the date of the original reference dataset run; and

(7) LFLG is a flag defined for each output power setting (see subroutine DELTA6).

If the sample problem in Appendix C is used as a guide, there should be sufficient comment statements in this subroutine to follow the data being printed. The summary of the output data includes the reference file comdeck names for all reference data used to interpolate the profile data at the output power setting. Information in arrays IREQC is used to print these comdeck names.

SUBROUTINE RDFILE(NFFLY1,NFFLY2,)*

This subroutine is called from the MAIN routine when the command line variable ARGS in the MAIN routines is NULL. The subroutine arguments NFFLY1 and NFFLY2 are two twenty-four byte character variables used to store the NOISEFILE database filenames for military and civil aircraft, respectively. When the command line is NULL, these two filenames must be defined in the MAIN routine. The asterisk in the argument list is an alternate RETURN label which is used to return control to the calling routine when an error has occurred.

This subroutine performs the following functions:

(1) Unit 1 is opened for I/O to the display;

(2) The program queries the operator for the OMEGA 10 setup filename which must be a standard DOS filename with a maximum of twelve characters. This file is opened on Unit 5 by the program. The ERRFLG is set to TRUE if the operator does not enter an exiting filename.

(3) The program queries the operator for the profile dataset output filename which must be a standard DOS filename with a maximum of twelve characters. This file is opened on Unit 3 by program.

(4) The NOISEFILE database file with names stored in NFFLY1 and NFFLY2 are checked to be sure they exist. If they don't exist the ERRFLG is set to TRUE and the job is terminated. These files are not opened at this time.

(5) The list file is always opened on Unit 6 with filename OMEGA108.OUT. If this file already exists, the operator is queried for a new filename and given the option to terminate the job. If the job is terminated, the ERRFLG is set to TRUE.

SUBROUTINE CLFILE(NFFLY1,NFFLY2,ARGS,)*

This subroutine is called when the command line character variable ARGS contains filename information which must be decoded into the I/O filenames. This routine separates the command line string which may be up to 127 character long into the I/O filenames. This routine will only run when compiled with the Lahey compiler; it will not run with Microsoft FORTRAN which was formerly used with the OMEGA 10 program.

The subroutine arguments NFFLY1 and NFFLY2 are two twenty-four byte character variables used to store the NOISEFILE database filenames for Military and civil aircraft data, respectively.

The command line must contain five I/O filenames in the sequence listed here. Each file is described briefly as follows:

(1) The setup filename is decoded and opened on Unit 5;

(2) The list filename is decoded and opened on Unit 6;

(3) The profile dataset filename is decoded and opened on Unit 3;

(4) The first NOISEFILE database filename is decoded and stored in variable NFFLY1; and

(5) The second NOISEFILE database filename is decoded and stored in variable NFFLY2.

Each filename must be separated by a space on the command line. The first byte on the command line must not be a space. If an error occurs when opening or checking a file, the ERRFLG is set to TRUE and the job is terminated. If only military or only civil data are

available, the two NOISEFILE filenames may be the same; however, two database filenames must be entered on the command line. The two database files are never both open at the same time.

BLOCK DATA

The BLOCK DATA routine is the last routine in this program. It is used to define numerous variables used in labeled common throughout the program. See the program listing in Appendix I and the list of symbols in this program documentation to identify the variables defined in BLOCK DATA.

GENERAL OVERVIEW OF THE OMEGA 11 PROGRAM

The OMEGA 11 program, hereafter referred to as simply the "program", is designed to compute descriptions of the ground run-up noise of an aircraft in terms of tone-corrected perceived noise level (PNLTX), A-weighted overall sound level (ALX), and tone-corrected A-weighted overall sound level (ALTX) as a function of distance to the aircraft, aircraft power setting and meteorological conditions. These noise measure data (profile datasets) are computed for aircraft ground run-up reference data as outlined in AMRL-TR-73-107.[1] They are required as input to the NOISEMAP noise exposure forecast program.

To compute the above noise measure data for selected operation power settings, the program inputs all reference datasets for aircraft ACC from the NOISEFILE database. These reference datasets contain sound pressure level (SPL) data for 19 angles normalized to a reference distance of 250 feet and to standard day temperature (59°F), relative humidity (70%) and barometric pressure (29.92 inches Hg). The format of these data are described in Appendix G.

These reference spectra are then extrapolated to each of the 22 standard profile distances (from 200 to 25,000-feet) at the requested standard or non-standard weather conditions. PNLTX, ALX and ALTX noise measures are determined for each distance and angle from these extrapolated SPL spectra for the reference power setting. This program interpolates between two reference file power settings to compute the noise measure data for each power setting requested in the setup file. Noise measure data can be computed for any power setting within the range available in the reference file.

A brief summary of the program operation is given below:

(1) The program inputs the code sheet parameters described in Appendix B and reads the reference datasets for aircraft ACC from the reference file.

(2) The power setting data are ranked and the indices of the reference datasets required to interpolate each output power setting are defined.

(3) The cover page is printed when IPR is greater than zero.

(4) The aircraft summary page is always printed.

(5) If Delta N (DELN) is not zero, it is added to all spectra for all power settings.

(6) If print flag IPR is greater than zero, all reference datasets are printed.

(7) PNLTX, ALX and ALTX profile data for each requested power setting (PSC) are computed in sequence from low to high PSC:

(a) If the PSC is the same as one of the reference dataset power settings, the profile data are computed and no interpolation is required.

(b) If the PSC is not the same as a reference dataset power setting, the profile data are computed at the reference conditions for the nearest reference file power settings on each side of PSC and the PSC profile data are linearly interpolated. For many PSC'S, the reference profile data for at least one dataset will have been computed for the previous PSC and thus stored in the SENX array.

(8) If IEDIT equal zero, the PSC profile data are edited to select the 10 angles which best represent the profile dataset at the reference distance.

(9) For IEDIT greater than or equal to zero, all PNLTX, ALX and/or ALTX profile data requested by the MEAS program flag are written to the file opened on Unit 2.

(10) For IPR greater than zero, the PNLX, PNLTX, ALX and/or ALTX profile data are printed as requested by the MEAS flag. A plot is also printed for PNLTX, ALX and ALTX at the reference distance.

(11) After all data are analyzed for all aircraft or when an error occurs, the program terminates with a call to EXIT where the argument is one when an error has occurred or zero when there is no error.

The content and format of the above mentioned output can best be determined by consulting the sample problem in Appendix D.

The CDC FORTRAN extended (FORTRAN IV) computer language was used for the original version of this program. The common and subroutine features of the language were used extensively throughout the program to save computer time and memory.

Over the past ten years, this program was converted from CDC FORTRAN to FORTRAN 77 for the Perkin-Elmer and later to Microsoft and Lahey FORTRAN for the PC. Version 11.3 is currently being compiled with the Lahey compiler.

The following sections describe the detailed tasks accomplished by the program. It is intended to document the procedures within each subroutine at a level useful to either a programmer reading this while working with the code or a reader simply interested in what happens with a specific subroutine. The algorithms used to compute the noise measures are described in detail in the individual subroutines.

GENERAL ORGANIZATION OF THE OMEGA 11 PROGRAM

The general organization of the entire program is shown in Figure 4. The diagram indicate access to the various routines rather than program flow; for example, MAIN calls subroutine CDIST which in turn calls subroutine CPNL, CPTC and CAL and subroutine CPNL calls function FNOY. In general, program flow is from left to right in this diagram.

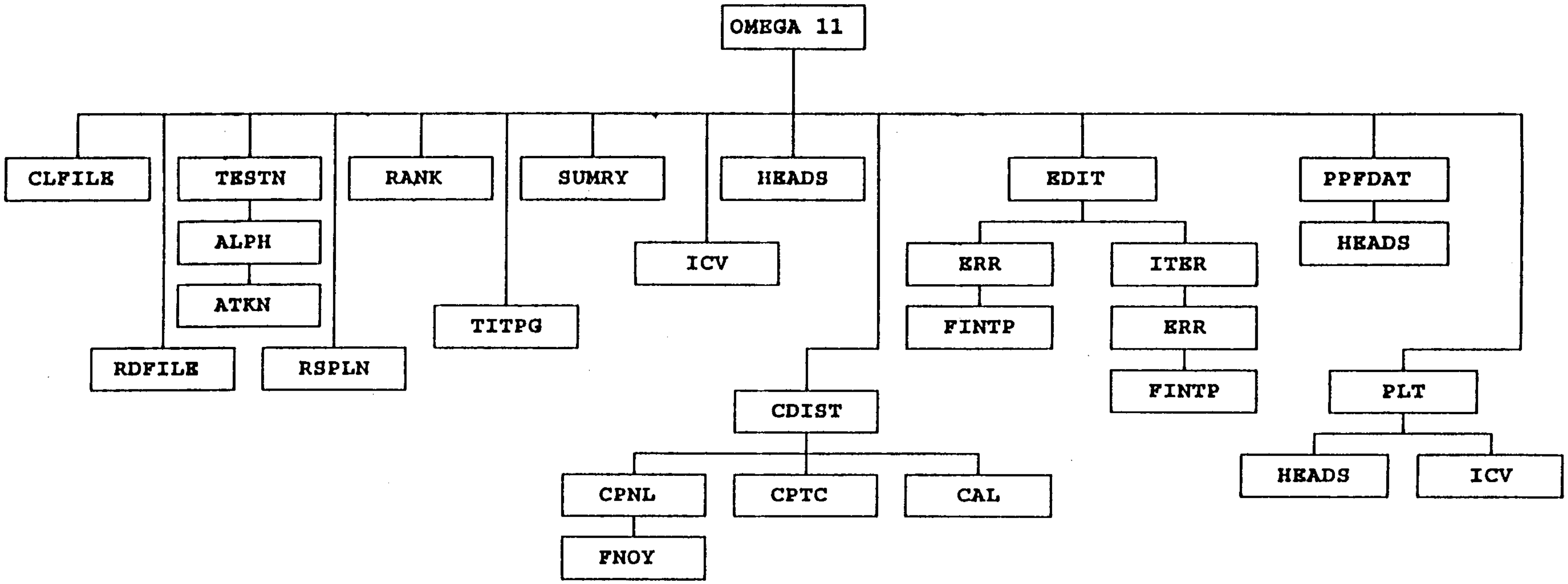
Using Figure 4 as a guide, this section summarizes in very general terms the functions performed by the entire program. This is meant to serve as an introduction for the reader to the functions of the individual subroutines.

The control routine, MAIN, reads the job control card and initializes several program and test variables. The required input and output files are opened in routines CLFILE and RDFILE. Subroutine TESTN is then called to read the code sheet test parameters, initialize numerous test variables, and call subroutine ALPH to compute the atmospheric absorption data for non-standard temperature and relative humidity.

Next the MAIN routine initializes additional test parameters and calls subroutine RSPLN to read all reference datasets for aircraft ACC from the file opened on Unit 7. The power settings from these reference datasets as well as the output power setting data are ranked by subroutine RANK which also determines the reference datasets required to compute the profile data for each output power setting.

The cover (IPR>0) and summary pages are printed by subroutines TITPG and SUMRY, respectively. Delta N (DELN) is added to all reference spectra (for DELN≠0) which are then printed (IPR>0) by the MAIN routine.

Subroutine CDIST is called to compute the PNLX, PNLTX, ALX and/or ALTX profile data (as requested by the MEAS flag) for the reference dataset power settings required to interpolate the output power settings (PSC). This interpolation between power settings is performed by the MAIN routine. Subroutine CDIST calls subroutine CPNL, CPTC and CAL to compute the PNLX, tone correction, and ALX data. These interpolated profile data are edited (IEDIT= 0) by subroutine EDIT to select the 10 angles which best describe the profile data at the reference distance. EDIT calls subroutine ERR which uses linear interpolation between the selected angles to determine how well they represent the profile function. The FINTP linear interpolation subroutine is used by subroutine ERR. EDIT also calls subroutine ITER which



Note: Data are written to the list file opened on Unit 6 by numerous routines throughout the program. The Main OMEGA11 routine and subroutines TESTN and RSPLN read input data from files opened on Units 5 and 7. Routine PPFDAT writes the profile datasets to the file opened on Unit 2.

Figure 4. General Organization of the OMEGA 11 Program.

attempts to reduce the interpolation errors by selecting the angles with the largest errors; ITER also calls ERR.

Subroutine PPFDAT writes the profile datasets to the file opened on Unit 2 (for IEDIT≥0) and writes (IPR>0) the list output for all computed measures to Unit 6.. Subroutine PLT prints (IPR>0) a plot of the PNLTX, ALX and ALTX noise level versus angle data computed for the reference distance. The angles for which profile data are written on Unit 2 are listed below the plot.

After computing and printing the profile data for each of the NP power settings, control is returned to label 10 in the MAIN routine and the program repeats the above for each aircraft until an end of file is read from the INPUT file.

DEFINITIONS OF SYMBOLS AND TERMINOLOGY USED IN THE OMEGA 11 PROGRAM

The symbols defined here are used in this report and/or in the OMEGA 11 program source listing. They are a subset of the complete symbol versus reference list. Many of the symbols used in this program are really dummy variables used in only one or two routines and redefined in each routine; most of these symbols are not included in this list of symbol definitions. Symbols which are arrays will be listed with their array dimensions. Variables I, J and K are usually but not always used as array subscripts as follows:

(1) The subscript "I" is a running index associated with any one spectrum (angle). It is also frequently used as a "dummy" index to initialize variables.

(2) The subscript "J" is a running index associated with any one band in the set of octave or 1/3 octave frequency bands. It is also an index associated with a specific profile measure.

(3) The subscript "K" is a running index associated with any one profile distance.

SYMBOL	*DESCRIPTION*
ACC	Three character aircraft code read from the code sheet and printed on all output pages and in all output datasets.
ALTX(19,22,2)	Profile tone-corrected A-weighted overall sound level in dBA for each angle and profile distance for two power settings.
ALX(19,22,2)	Profile A-weighted overall sound level in dBA for each angle and profile distance for two power settings.
ARGS	Character variable used to retrieve the command line argument list.
ASK	One byte character variable which contains an asterisk. ASK is used to check for the COMDECK name record. Also used as end of file flag.
ATN(31)	Data statement array containing the atmospheric absorption coefficients in dB per 1000 for standard day temperature and relative humidity.
ATN8(31)	Atmospheric absorption coefficients in dB per 1000 feet for OMEGA 11 profile output temperature and relative humidity.
ATNC(31)	Atmospheric absorption coefficients in dB per 1000 feet for OMEGA 11 reference input temperature and relative humidity (usually standard day conditions).
AW(31)	A-weighting coefficients in dBA.
BLK	A data statement variable containing a blank Hollerith character used in printing variable format data.
CBLK	Ten byte character variable which is filled with ten spaces or blank characters. It is used throughout the program to blank out character data.
COMD(6)	Character variable used to store the last four characters of each reference file COMDECK name.
CRI	Comdeck revision identifier (see code sheet).
CXD(19)	Computed tone correction for each angle for the reference distance (dB).
DATE	Date of computer run (see code sheet).
DATN(6)	Date of the OMEGA 8 computer run which generated the reference dataset.
DELN	Noise adjustment factor added to the reference spectrum (dB).
DIST	Distance in feet to which the reference file data in NOISEFILE are normalized (presently 250 feet).
EA(22,24)	Excess atmospheric attenuation in dB for bands 17 to 40 and distances 200 to 25000 feet (subroutine CDIST).
ER(19,3)	Profile dataset angle selection error data for each angle and measure (dB).

SYMBOL	*DESCRIPTION*
ERMAX	Maximum acceptable angle selection error in dB; no attempt is made to improve the angle selection for errors less than ERMAX.
FIMPR8	Characteristic impedance ratio using reference and profile output temperature and barometric pressure.
FJ	Constant used in the perceived noise level computations; FJ=0.15 for 1/3 octave band data.
FL(24,5)	Data statement array used in noy computations (functions FNOY) containing the band sound pressure levels in dB given in Table 4.
FM(24,4)	Data statement array used in noy computations (function FNOY) containing the reciprocals of the slopes given in Table 4.
FMT(22)	Variable format array used to print profile data in subroutine PPFDAT.
FMXER	Maximum angle selection error permitted without an error message being printed (see code sheet).
FREQ(31)	Data statement array containing the frequency values in Hz in character format for printing.
FREQ3(24)	Geometric mean and lower limiting frequencies required to compute atmospheric absorption coefficients for 1/3 octave band data.
FSPL(19,31,6)	Normalized reference SPL in dB for each angle, frequency band, and operation power code.
IBNH	Largest band number index (31 corresponds to band 40).
IBNL	Initial band number index (1 corresponds to band 10).
IC	Index which is usually associated with output power setting (PSC) data.
ICC	Integer variable containing the power setting index for the specific power setting being analyzed.
ID	Integer variable used to store the integer value of the standard reference distance.
IEDIT	Program flag which controls the quantity of profile data written to the file opened on Unit 2 (see code sheet).
IFC(6)	Program flag used to flag special case output power setting data (see code sheet).
IFCC	Index used to count the number of IFC's > 0.
IFI(6)	Program flag used to flag special case (Afterburner, etc.) reference file power setting data.
IFII	Index used to count the number of IFI's > 0.

SYMBOL	*DESCRIPTION*
IH	Index of the largest frequency band defined for this test (IH=31 for band 40).
IH8	Profile output relative humidity (code sheet input).
IHH	Reference relative humidity (70%).
II	Index which is frequently associated with the computation of the two sets of profile data used to interpolate profile data at the requested power settings.
IL	Index of the lowest frequency band defined for this test (IL=l for band 10).
IPAGE	Page number counter.
IPR	Program print control flag (see code sheet).
IPRCK(6)	Integer variable used to flag the reference data required to compute the requested output.
IR(19)	Array used to print integer values of the reference SPL data.
IRD	Profile distance index which corresponds to the reference minimum slant range (presently IRD=2).
IREQ(2,6)	Index of the one or two reference datasets required to compute the profile data for each requested power setting.
IT	Reference temperature in degrees F (always 59°F).
IT8	Profile output temperature in degrees F (see code sheet).
IVER	Program version code.
L	Index frequently associated with data for a specific reference file power setting.
M	Program flag indicating whether data are for octave (M=l) or 1/3 octave (M=3) band center frequency (always 3 in this program).
MEAS(3)	Program job control variable which flags the profile measures to be computed (see code sheet).
MM	Increment of the frequency index (one for 1/3 octave band data).
N	Number of reference dataset operation power codes read from the reference file (Unit 7) for aircraft ACC.
NC	Number of angles for which SPL spectra are defined in the reference dataset (always 19 for the present reference datasets).
NFRUN1	Twenty-four byte character variable used to store the first reference filename.
NFRUN2	Twenty four byte character variable used to store the second reference filename.

SYMBOL	*DESCRIPTION*
NN	Maximum number of reference file operation power codes permitted for each aircraft (NN=6).
NP	Number of output operation power codes (power settings) to be computed for this aircraft.
NPM	maximum number of profile operation power codes permitted for each aircraft (NPM=6).
NR(17,3)	Change in slope rank data computed in the angle selection routines for angles 10 to 170 degrees for each measure. Angles with rank greater than nine are included in the final profile dataset.
NRC(6)	NRC(K) contains the index of the output power setting data (in arrays PSC and PSCF) whose power setting rank is K.
NRI(6)	NRI(K) contains the index of the reference power setting data (in arrays PS and PSIF) whose power setting rank is K.
OPC(6)	Reference operation power codes.
OPCC(6)	Output operation power codes.
OPCDM	Two byte character variable containing the output operation power code.
OPCSP(14)	Special case operation power codes for which no interpolation is permitted. This array must be updated when new codes are added.
OPD(2,6)	Power description data for each reference operation power code (20 characters).
OPD1, OPD2	Power description data defined for output power settings when the reference and output power settings are the same.
P1	Reference barometric pressure in inches Hg (always 29.92 inches Hg).
P8	Profile output barometric pressure in inches Hg.
PNLTX(19,22,2)	Profile tone-corrected perceived noise level in PNdB for each angle and distance for two power settings.
PNLX(19,22,2)	Profile perceived noise level in PNdB for each angle and distance for two power settings.
PS(6,6)	Power setting data for each reference file operation power code (power setting value and units in character format).
PSC(6)	Power setting data for each profile output operation power code in character format (see code sheet).
PSCF(6)	Numeric form of PSC(6) data defined above.

SYMBOL	*DESCRIPTION*
PSIF(6)	Numeric form of the first power setting for each reference operation power code in PS(6,6) above; e.g., PSIF(I) =PS(1, I).
PSU	Power setting units for the profile output data.
PTC	Tone correction in dB.
PV	Profile version code (see code sheet).
RMS(3)	Root mean square of the angle selection error for each measure.
RUN(6)	Two character run number from each reference dataset.
RUNC(6)	Data statement array containing run numbers 01 to 06 in character format. These run numbers are assigned to the output data in power setting sequence.
SENX(19,22,12)	Array equivalent to arrays PNLX through SENXD in blank common where SENXD(19,22,4) contains the interpolated profile data for the measures.
SPLX(19,31)	Profile sound pressure, level in dB for each angle (spectrum).
SX(22)	Distance data in feet for the 22 profile distances.
T12(2)	Data statement array used to set up the variable formats for the profile data tab output.
TEST(6)	Ten character test number from each reference dataset.
TT(6,6)	Two lines of 25 characters from the reference dataset describing the noise source. The two lines from the first reference dataset are printed in the Noise Source/Subject block on all output pages.
TYPE(3)	Five byte character variable containing the PNLT, AL and ALT noise measure type names for printing.

DETAILED DESCRIPTION OF THE OMEGA 11 PROGRAM

This section discusses the MAIN routine and each subroutine in the OMEGA 11 program. Procedures within most routines are documented at a level useful to a programmer reading this while working with the code or a reader interested in what happens within a specific subroutine. Most routines contains numerous comments which should be very helpful in following the code.

The program algorithms and I/O are discussed in the routines in which they are coded. The program code sheet in Appendix B and the sample problem in Appendix D are referenced to simplify the description of the input and output. The more complex subroutines are supplemented by flowcharts drawn from the point of view of function performed rather than block instructions.

COMMON VARIABLES

Extensive use is made of common in the program for communications between the various routines. Many of the storage locations in blank common are used in different ways or with different variable names throughout the program. This was done to reduce the memory required to run the program on the old CDC computers. Several of the large arrays are included in blank common rather than labeled common because on the CDC 6600 computer a large blank common reduces the total memory required to load and execute the program. The variables used in labeled common are usually of a similar type and/or used in many of the same subroutines.

The variables assigned to blank and labeled common in the MAIN routine and the total common length are listed in Table 6. The subroutines in which the labeled common are used are listed in Table 7. All blank and labeled common are included in the MAIN routine. All common variables are defined in the complete list of symbols at the beginning of the report. The blank and labeled common are described in the following paragraphs.

CHAR Common

All the variables in this labeled common are character variables. Most of the variables were formerly part of HEADC labeled common before all character variables were put in this CHAR labeled common when the program was converted to run on a PC. Most of these variables are used in the list and COMDECK output to identify the data. There are 456 bytes in this labeled common.

TABLE 6

MAIN ROUTINE VARIABLES IN BLANK AND LABELED COMMON

		LABELED COMMON			
	Blank Common	ATTC	HEADC	CHAR	ERRORS
	M	ATNC(31)	DELN	ACC	ERRFLG
	MM	ATNR(31)	FIMPR8	ASK	
	IL	SX(22)	IC	BLK	
	IH		ICC	CBLK	
	NC		IFC(6)	COMD(6)	
	L		IFCC	CRI	
	N		IFI(6)	DATE	
	ID		IFII	DATN(6)	
	DIST		IHH	OPC(6)	
	MEAS(5)		IH8	OPCC(6)	
	FSPL(19,31,6)		IPAGE	OPCDM	
	SPLX(19,22)		IVER	OPD(2,6)	
	PNLX(19,22,2)		IT	OPD1	
	PNLTX(19,22,2)		IT8	OPD2	
	ALX(19,22,2)		NP	PSU	
	ALTX(19,22,2)		P1	PS(6,6)	
	SENXD(19,22,4)		P8	PSC(6)	
	IR(19)		PSIF(6)	PV	
	IDPRCK(6)		PSCF(6)	RUN(6)	
	DMY(202)		NRC(6)	RUNC(6)	
				TEST(6)	
				TT(6,6)	
Length in Bytes	36,828	336	180	456	4

TABLE 7

SUBROUTINES CONTAINING THE LABELED COMMON

ATTC	CHAR	HEADC	ERRORS
CDIST	BLOCK DATA	BLOCK DATA	CLFILE
TESTN	HEADS	HEADS	RANK
	PLT	PPFDAT	RDFILE
	PPFDAT	RANK	RSPLN
	RANK	RSPLN	TESTN
	RSPLN	SUMRY	
	SUMRY	TESTN	
	TESTN	TITPG	
	TITPG		

ERRORS Common

This common contains the ERRFLG which is used to set the exit code. ERRFLG is set to TRUE when there is an error.

Blank Common

The 36,828 bytes used by blank common in the MAIN routine are the maximum required in any routine in the program. Almost all routines use some blank common but only a few require the 36,828 bytes. The variable names assigned to blank common vary throughout the program. Most variables are defined to communicate with several subroutines and then redefined for the next series of routines. In several cases variables are changed or equivalenced to simplify the computations and/or output routines.

ATTNC Common

These variables are used to extrapolate data from a given set of distance and weather conditions to a new set of conditions. For example, from reference distance and standard day conditions to the profile distances at the profile temperature and humidity. These 336 bytes are defined the same throughout the program.

HEADC Common

These numeric variables are used to store the weather and power setting data required to perform the interpolation at the output conditions. Some of these data are printed in the page header blocks and the output COMDECK comment cards. The 180 bytes in this labeled common are defined the same throughout the program.

MAIN PROGRAM

MAIN is the executive routine for the entire OMEGA 11 program. Its principal function is to call the subroutines required to read the input data, perform the data analysis, and write the list and data file outputs. However, the program also reads the program control parameters, initializes numerous test variables, interpolates the profile noise levels as a function of power setting, and prints part of the output. The MAIN routine is discussed in the following paragraphs using the program listing in Appendix J, the flowchart in Figure 5, and the sample problem in Appendix D as guides.

Data Statement Arrays

The FREQ data statement array contains frequency data (Hz) in character format which is printed in the frequency versus SPL listings of the reference datasets.

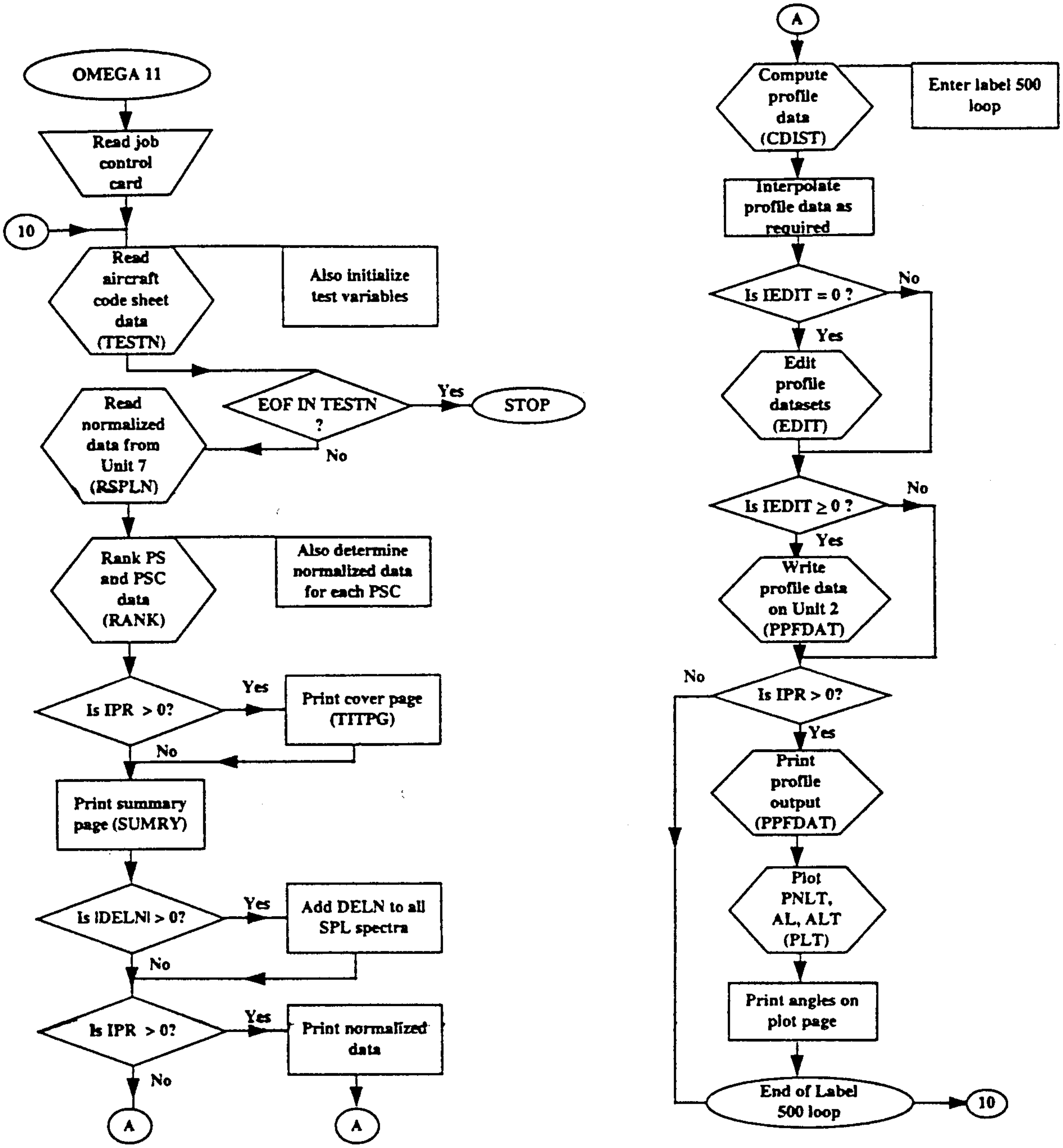


Figure 5. Flowchart for OMEGA 11 MAIN Routine.

Initialize Test Variable

The first segment of this routine performs the following variable initialization steps:

(1) The Lahey FORTRAN routine GETCL is called to get the command line argument which is stored in character variable ARGS. If ARGS is NULL then subroutine RDFILE is called to open and/or check the I/O files. If ARGS is not NULL then subroutine CLFILE is called to get the I/O file names from ARGS and then open and/or check the files.

(2) The SX standard profile distance array is evaluated:

$$SX_I = \text{antilog}\left(\frac{I+22}{10}\right) \qquad \text{feet}$$

where I is the distance index running from 1 to 22.

(3) The code sheet job control record is read once per execution of the program.

(4) Subroutine TESTN is called to read all test (aircraft) code sheet parameters and initialize numerous other test variables based on these code sheet input data (e.g., atmospheric absorption data).

Read Reference Data

The program calls subroutine RSPLN to read the reference data for aircraft ACC from the file opened on Unit 7. This Unit 7 file may contain data for numerous aircraft, however, all data for aircraft ACC must be back to back. All reference data (for ACC) for normal power settings are stored in the program; the special case (afterburner, etc.) power setting data are stored only when at least one special case output power setting is requested. Note that array OPCSP in subroutine RSPL must be updated when new special case OPC's are added to NOISEFILE.

Setup Interpolation Index Array

Subroutine RANK is called to rank from low to high the input and output power setting data. These ranked power setting data are used to determine the reference data required to interpolate the profile data for each output power setting. The indices of these reference data are stored in array IREQ.

Subroutine TITPG prints the cover page when flag IPR is greater than zero. Subroutine SUMRY uses the above IREQ array data to print the aircraft summary page which is the only list output when IPR is less than one.

Adjust and Print Reference Data

The following constant is computed as required by subroutine CDIST later in the program:

$$Dl = 10 \log (FIMPR8) + 20 \log (DIST)$$

where

FIMPR8	=	the characteristic impedance ratio computed in subroutine TESTN.
DIST	=	the reference distance in feet.

The statement label 55 loop checks array IREQ to determine which reference data are actually required for this aircraft analysis. If Delta N is not equal to zero, it is added to all spectra in these required datasets which are then printed in the label 150 loop when flag IPR is greater than zero. Subroutine HEADS prints each reference page header block. The overall SPL is also computed and printed below the last SPL band. The overall SPL is defined as follows:

$$\text{Overall} \qquad SPL = 10 \log \sum_{J} \text{antilog}\left(\frac{FSPL_{I,J,L}}{10}\right)$$

where

$FSPL_{I,J,L}$ = reference band SPL in dB at distance DIST and for angle index I, band index J, and power setting index L.

Single Event Profile Data

The statement label 500 loop computes the single event profile noise data for each of the NP power settings (PSC). Each of the NP power settings will require profile data from one reference dataset when the PSC is the same as a reference power setting or from two reference datasets when the PSC must be interpolated. The dataset indices required for each PSC are stored in array IREQ. Subroutine CDIST computes the profile data requested by the MEAS flag (PNLTX, ALX and/or ALTX) for each reference dataset.

Note that profile data are computed and stored for no more than two reference datasets at any one time; however array IREQ is set up and checked to avoid duplicate computations. This limit of two was set to keep the program memory requirements within reasonable limits for the old CDC computers.

When no power setting interpolation is required, the final profile data are stored in array SENX (by subroutine CDIST) as indicated in the program comment statements (see label 370 and

380). When the PSC are not the same as a reference file power setting, the profile data are interpolated for each angle (I) and distance (K):

$$SENX_{I,K,J} = \left[\frac{SENX_{I,K,J1} - SENX_{I,K,JJ}}{PSIF_{L2} - PSIF_{L1}} \right] \left[PSCF_{ICC} - PSIF_{L1} \right] + SENX_{I,K,JJ} \quad \text{PNdB or dBA}$$

where

$SENX_{I,K,J}$ = the final profile data in PNdB or dBA for the I^{th} angle, K^{th} distance and measure index J (J ranges from 9 to 12).

$SENX_{I,K,J1}$ = the profile data for the $J1^{th}$ measure index from the second (L2) reference dataset for I and K.

$SENX_{I,K,JJ}$ = the profile data for the JJ^{th} measure index from the first (Ll) reference dataset for I and K.

$PSIF_{L2}$ = power setting from the second (L2) reference dataset.

$PSIF_{L1}$ = power setting from the first (Ll) reference dataset.

$PSCF_{ICC}$ = the output profile power setting for which the profile data are interpolated.

<u>Edit and Write Profile Data</u>

When flag IEDIT is zero, subroutine EDIT is called to select the ten angles which best describe each profile measure at the reference distance. The ten selected angles are angles 0 and 180 degrees plus the eight angles from 10 to 170 degrees for which the value of array $NR_{I,J}$ is greater than nine, where I is the angle index (I=l to 17) and J is the measure index (J=l to 3 for PNLTX, ALX and ALTX).

Subroutine PPFDAT is called to write the final profile data for the requested measures (MEAS>0) to the file opened on Unit 2 and to print the profile data list output. The quantity of data written to Unit 2 depends on the value of the IEDIT flag:

(1) For IEDIT<0, all Unit 2 output are omitted.

(2) For IEDIT=0, write the 10 angles selected by subroutine EDIT.

(3) For IEDIT=1, write all 19 angles of profile data.

A description of the content and format of these profile datasets is given in Appendix H.

The profile data listings are printed when program flag IPR is greater than zero. They contain data for all 19 angles and 22 distances; one page is printed for each measure (listing includes the PNLX data when PNLTX is computed).

Subroutine PLT prints (IPR>0) a plot of PNLTX, ALX and ALTX noise level versus angle for the reference distance. This plot is very helpful when selecting the ten angles (manually) or when checking the angles selected by the edit routine. The angles written to Unit 2 for each measure are printed below this plot.

At this point, control is returned to label 10 to begin the next aircraft analysis or to terminate the job. An OMEGA 11.3 job will terminate with a call to EXIT(1) if an error has occurred (ERRFLG = TRUE) or a call to EXIT(0) when the job terminates without an error (ERRFLG = FALSE)..

SUBROUTINE TESTN(NPM)

This subroutine is called from the MAIN routine to input the aircraft code sheet parameters. The subroutine also initializes numerous test variables and sets code sheet default parameters. There should be sufficient comment statements in the listing to document most of the coding.

Method

The first segment of the subroutine (to label 10) reads the code sheet test parameters and sets the program default values. The computer job is terminated when an end of file is read from Unit 5. The code sheet parameters and default conditions are described in Appendix B. The reference temperature (IT8) is converted from °F to °C as required to compute the impedance data.

The impedance ratio for reference and profile output conditions is:

$$FIMPR8 = \left[\frac{273+TM}{273+TM8}\right]^{1/2}\left[\frac{P8}{P1}\right]$$

where

TM = reference temperature (15°C)

TM8 = profile output temperature in °C

P1 = reference barometric pressure (29.92 in Hg).

P8 = profile output barometric pressure in inches Hg.

Subroutine ALPH is called to compute the atmospheric absorption data in dB per 1000 feet for non-standard day profile conditions (ATN8). For standard day conditions (59°F and 70%), these absorption data are stored in the ATN data statement array.

SUBROUTINE ALPH(REL,TEMP,ABC)

This subroutine is called from subroutine TESTN to compute the octave or 1/3 octave band atmospheric absorption data in dB per 1000 feet for non-standard day temperature and relative humidity. This subroutine is the same as subroutine ALPH in the OMEGA 10 program.

FUNCTION ATKN(X,Y,N,K,XI)

This function is a general AITKEN interpolation function, used by subroutine ALPH to compute the normalized molecular absorption coefficient. ATKN was obtained from the ASD computer center library (old IBM 7094 library). Since this is a common interpolation function defined in most numerical methods texts, no additional description will be given.

SUBROUTINE HEADS(IPH)

This subroutine is called from the MAIN routine and from subroutines CDIST and PLT to print page header blocks at the top of all output pages. The header blocks are 112 characters wide for the reference sound pressure level output (label 2000 formats) and 126 characters wide for all profile output pages (label 3000 formats). The IPH subroutine argument determines the specific page header block printed for each call.

The content and format of the header blocks can best be observed by consulting the sample problem in Appendix D. This subroutine should contain sufficient comment statements to identify the data being printed. It may also be helpful to consult the subroutine HEAD documentation in the OMEGA 10 program; the five categories of data described there also apply here.

SUBROUTINE RSPLN(NN,IERR)

This subroutine is called from the MAIN routine to input one reference dataset from the file opened on Unit 7 for each normal operation power code (OPC) in the reference file (NOISEFILE) for aircraft ACC. When the Unit 7 file contains more than one reference dataset for one or more OPC'S, only the last dataset is stored by this routine. The special case operation power code data (Afterburner, Wet or With Jets) are read only when at least one special case was

requested on the code sheet (IFCC>0). The special case operation power codes are stored in array OPCSP which must be updated when new codes are added to the NOISEFILE database. NN is the maximum number of datasets for which storage has been allocated in the program (NN=6). The IERR argument is a program error flag which returns codes of 1 to 4 for different type input errors.

Band 10 to 16 were added to all reference data in 1992. The SPL levels are zero for these seven bands for all current runup data. The label 150 loop checks these seven bands for all spectra for the current aircraft. Variable IL is set equal to the band index of the first non zero band.

The flowchart in Figure 6 and the comment statements in the listing should make it easy to follow the data being read; the format and content of these ground run-up reference datasets are also given in Appendix G.

FUNCTION ICV(R)

This function is used in the MAIN and PLT routines to convert variable R to an integer. R is rounded up when the fractional part is greater than or equal to 0.5. Function ICV could be replaced by function NINT which is a standard FORTRAN 77 function.

SUBROUTINE CDIST(IRD,D1,II)

This subroutine is called from the MAIN routine to compute the single event noise profile data (e.g., PNLTX versus distance for 22 distances from 200 to 25,000 feet) from the reference SPL spectra stored in array FSPL.

The subroutine argument IRD is the index of the standard distance which is within one percent of the reference distance. IRD is defined in this subroutine and returned to the MAIN routine. For the present standard reference distance DIST of 250 feet, IRD will always be two. D1 is a constant computed in the MAIN routine and defined in the next section. II is a power setting related index (see MAIN routine).

The EA data statement array contains the excess attenuation data for frequencies 50 Hz to 10,000 Hz and distances 200 to 25,000 feet. These data are presented in Table 3 which was taken from AAMRL-TR-84-017.[3] This table also contains the data for bands 10 through 16 which are the same as for band 17.

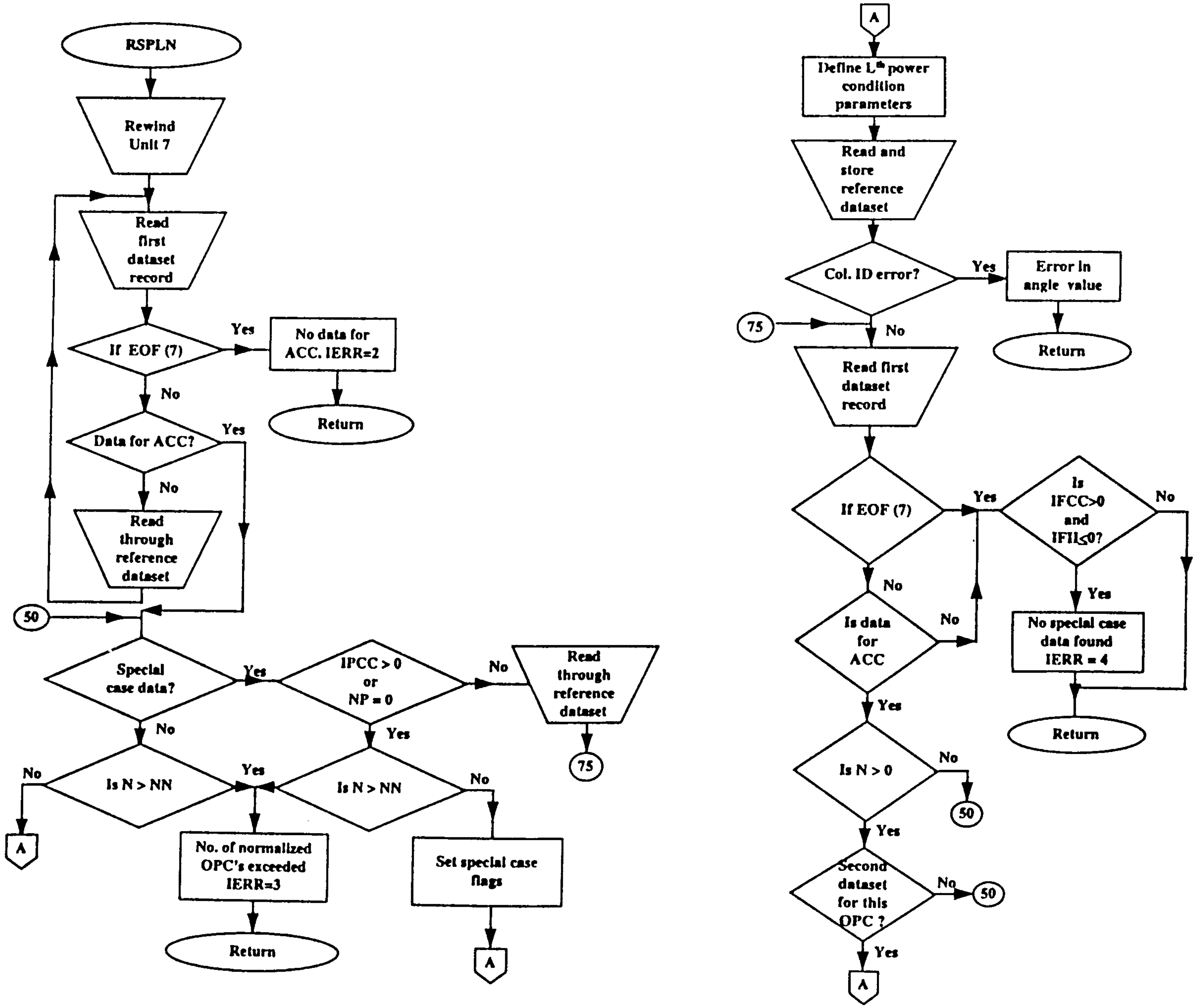


Figure 6. Flowchart for Subroutine RSPLN.

Extrapolated SPL Data

The first segment of this subroutine (statement label 135 loop) computes the SPL spectrum extrapolated to the K^{th} standard profile distance:

$$SPLX_{I,J} = FSPL_{I,J,L} + D1 - EAD - \frac{(SX_K)(ATN8_J)}{1000} - 20\log(SX_K) + \frac{(DIST)(ATNC_J)}{1000} \qquad \text{dB}$$

where

$SPLX_{I,J}$	=	the calculated band SPL in dB at the K^{th} profile distance from the source for angle index I and frequency index J.
$FSPL_{I,J,L}$	=	reference band SPL in dB at distance DIST and for angle index I, band index J, and power setting index L.
Dl	=	defined in the MAIN routine
	=	10 log (FIMPR8) + 20 log (DIST)
FIMPR8	=	the ratio of profile and reference characteristic impedance (see subroutine TESTN).
DIST	=	reference distance in feet from the source (250 feet).
EAD	=	excess atmospheric attenuation of sound in dB over distance SX_K for frequency band index J.
SX_K	=	the K^{th} standard profile distance in feet (defined in the MAIN).
$ATN8_J$	=	sound absorption coefficient in dB per 1000 feet for frequency index J and profile output temperature and relative humidity.
$ATNC_J$	=	same as above except for standard day conditions (reference)

Frequency Weighted Measures

The statement label 250 loop controls the computation of the perceived noise level (PNLX), A-weighted overall sound level (ALX) and tone correction (CXD --- reference distance only) for each spectrum (angle) for the K^{th} profile distance and II^{th} power setting. These data are computed only when requested by the MEAS program flag. Subroutine CPNL is called to compute the PNLX data for the I^{th} spectrum. If PNLX data are missing beyond the second distance, PNLX is extrapolated linearly from the last two good points:

$$PNLX_{I,K,II} = (2)(PNLX_{I,K-1,II}) - PNLX_{I,K-2,II} \qquad \text{PNdB}$$

The A-weighted overall sound level for the I^{th} spectrum are computed by subroutine CAL. These ALX data are the final A-weighted profile data. The tone correction data are computed for the I^{th} spectrum and reference distance (IRD) by subroutine CPTC.

<u>Single Event Profile Data</u>

The PNLTX and ALTX profile data are computed by adding a smoothed tone correction to the PNLX and ALX data (label 400 loop):

$$PNLTX_{I,K,II} = PNLX_{I,K,II} + (C1)(CXD_I) \qquad \text{PNdB}$$

$$ALTX_{I,K,II} = ALX_{I,K,II} + (C1)(CXD_I) \qquad \text{dBA}$$

where

CXD_I = the tone correction in dB for the I^{th} spectrum at the reference distance.

C1 = 1.0 for distances 200 to 3,150 feet.

= (0.2)(18-K) for distances 4,000 to 8,000 feet (K=14 to 17).

= 0.0 for distances 10,000 to 25,000 feet.

SUBROUTINE CPNL(FJ,I,II)

This subroutine is called from subroutine CDIST to compute the perceived noise level (PNLX) for the I^{th} spectrum (angle), K^{th} distance and II^{th} power setting. Function FNOY is used to compute the noy data for each SPL data point. Subroutine argument FJ is 0.15 for this 1/3 octave band data. The PNLX algorithms applied in this subroutine are the same as applied in subroutine CPNL in the OMEGA 10 program; thus no additional documentation will be given here.

FUNCTION FNOY(SPL,JJ)

This function is used in subroutine CPNL. It is the same as function FNOY described in the OMEGA 10 program documentation.

SUBROUTINE CPTC(PTC,I)

This subroutine is called from subroutine CDIST to compute the tone correction (PTC) for the I^{th} spectrum (angle) and the reference distance. This subroutine is the same as subroutine CPTC described in the OMEGA 10 program documentation.

SUBROUTINE CAL(I, II)

This subroutine is called from subroutine CDIST to compute the A-weighted overall sound level (ALX) for the I^{th} spectrum, the K^{th} distance, and the II^{th} power setting. The ALX algorithm is the same as described for subroutine CAL in the OMEGA 10 documentation. Many of the variable names are different in this subroutine; however, they should be defined in sufficient detail in comment statements in the listing.

SUBROUTINE PPFDAT(J1,J2,JI,L1,L2,IPR,IEDIT)

This subroutine is called from the MAIN routine to write (IEDIT>-1) the PNLTX, ALX, and/or ALTX single event profile data to the file opened on Unit 2 and to print (IPR>0) the PNLX, PNLTX, ALX and/or ALTX list output to the OUTPUT file. For both types of output, only measures requested by the MEAS flag are printed. To simplify the coding and reduce the number of write statements, these profile data are stored in the blank common array SENX.

The subroutine arguments are defined as follows:

(1) J1 and J2 are the first and last indices of the SENX profile data and JI is the increment of J1 to J2.

(2) L1 and L2 are the indices of the normalized data used to compute (interpolate) the profile data for the requested power condition.

(3) IPR is the program list print flag.

(4) IEDIT is the profile flag which controls the quantity of data printed to the file on Unit 2.

<u>**Write Profile Datasets to Unit 2**</u>

The number of angles of profile data written to Unit 2 by the label 100 loop depends on the value of the IEDIT program flag. All 19 angles or the 10 angles selected by the EDIT routine are written for IEDIT equal to one and zero, respectively. A complete description of the content and format of the 10 angle ground run-up profile datasets is given in Appendix H. When all angles are written, the final 10 angles which most accurately describe each noise profile must be selected from these 19 angles. The plot of the profile data for the reference distance, printed by subroutine PLT on output Page J, is included to aid in the selection of these 10 angles.

Print Single Event Data

The remainder of this subroutine (label 400 loop) prints the four single event measures (PNLX, PNLTX, ALX, and ALTX) on Pages D through G, respectively. These data are printed from the SENX array using the J1, J2, and JI subroutine arguments defined above. Subroutine HEADS is called to print each page header block. All single event data less than zero are blanked out in the printout. The content and format of these pages can best be observed by consulting the sample problem in Appendix D.

SUBROUTINE TITPG

This subroutine is called from the MAIN routine to print the cover or title page for each test. This cover page provides the following information:

(1) The aircraft name and code for which the data were measured.

(2) The program used in the test analysis.

(3) The date of the computer run.

(4) The types of data computed and printed for the test.

The content and format of this title page can best be understood by consulting the sample problem in Appendix D. With this sample problem title page as a guide, there should be no problem in following the coding.

SUBROUTINE PLT(IRD,JJ1,JJ2,JJI)

This subroutine is called from the MAIN routine to print a plot of PNLTX, ALX, and ALTX versus angle. These data are for the reference distance (IRD = 250 feet) from the profile datasets. The content and format of this plot can best be understood by consulting Page J in the sample problem in Appendix D. This plot simplifies the selection or checking of the 10 angles which most accurately describe the profile data.

The JJ1, JJ2 and JJI subroutine arguments are the indices and the index increment of these profile measures in array SENX. IRD is the index of the reference distance in array SENX.

Method

The first segment of this subroutine initializes the P plot array, calls subroutine HEADS to print the page header block, and prints the plot symbol identification line, the top border line and the first grid line below the header block. The label 25 loop determines the maximum

PNLTX value which is then used to set up the abscissa scale values. The maximum annotated scale value is the first multiple of ten greater than this maximum PNLTX. The minimum value is 100 less than the maximum. The actual minimum and maximum values are two less and two greater than these annotated scale values.

The label 200 loop sets up and prints the plot for each of the 19 angles. The ordinate annotation and title and grid pattern are determined from the angle index I. The label 120 loop scales the PNLTX, ALX and ALTX data for the I^{th} angle and sets up the corresponding symbol in the plot array. The data are then printed and the plot array is reinitialized with the data stored in array SAV. There should be sufficient comments in the coding to follow the setup and printing of the data.

SUBROUTINE RANK(IREQ,IERR)

This subroutine is called from the MAIN routine to determine the reference data (one or two datasets) required to compute the profile output for each requested output power setting (PSC or PSCF). The indices of these reference data are stored in array IREQ for each power setting. Subroutine argument IERR is a program error flag which is returned greater than zero when errors occurred in this subroutine.

Method

Internal reads are used to convert the input (PS) and output (PSC) power setting data from character format to floating point. The floating point data are required for ranking and interpolating the data.

Next this subroutine ranks all normal reference file power setting data (PSIF) and all normal requested output power setting data (PSCF). The special case data which may not be interpolated (Afterburner, Wet and With Jets) are not ranked. These ranked power setting data are then used to determine which reference data are required to interpolate profile data for each (IC) output power setting. Indices of these reference data are defined in array IREQ for each output power setting. If profile data for the same reference power setting are required to interpolate profile data for two or more consecutive output power settings, the index of this reference power setting is stored in consecutive columns in the same row in array IREQ.

Profile data at these reference power settings are later extrapolated from the reference SPL spectra (see MAIN routine) as requested in array IREQ; thus, only those profile reference data required to interpolate data at the profile output power settings are extrapolated by the program. Also, to conserve storage, reference profile data storage is limited to the two power

settings required to compute each output profile power setting; however, IREQ is checked to avoid duplicate reference profile computations.

There should be sufficient comments in the coding to follow the setup of the IREQ index array.

SUBROUTINE SUMRY(IREQ,IEDIT,FMXER)

This subroutine is called from the MAIN routine to print the OMEGA 11 summary page which lists job identification parameters as well as a summary of the input and output data. This page is the only list output when the program print flag, IPR, is less than one. The subroutine arguments are defined as follows:

(1) IREQ is an array containing the indices of the reference datasets used to interpolate the profile data.

(2) IEDIT is a program flag which controls the editing of the profile data.

(3) FMXER is the maximum error permitted in the EDIT subroutine.

If the sample problem summary page is used as a guide, the coding in this subroutine should be easy to follow.

SUBROUTINE EDIT(IRD,J1,J2,JI,ACC,PSC,PSU,FMXER)

This subroutine is called from the MAIN routine to select the ten angles for each measure (PNLTX, ALX and ALTX) which best define the angle versus noise level data for that measure at the reference distance (250 feet). Actually only eight angles are selected by this routine, since angles 0 and 180 degrees are always included. Reference distance profile data for all three measures at all 19 angles are used to compute the three sets of ten angles, even though only one or two of the measures are required for the data analysis (see MEAS program flag).

The subroutine arguments are defined as follows:

(1) IRD is the index of the reference distance.

(2) J1 and J2 are the indices of the PNLTX and ALTX data in array SENXD and JI is the index increment (ALX data is in index J1 + JI).

(3) ACC is aircraft code, PSC is the power setting for which the data are being computed, and PSU are the power setting units.

(4) FMXER is the maximum error permitted in this EDIT routine (default FMXER=5.0).

Method

The following outline describes the method used to obtain the best set of ten angles:

(1) Compute the 18 angle to angle changes in PNdB or dBA for each measure (slopes) and store in array SL.

(2) Compute the 17 changes in slope (DSL) for each measure and assign to angles 10, 20, ..., 170 degrees. Store these data in array DSL.

(3) Rank the absolute values of these 17 changes in slope (DSL) for each measure (label 50 loop).

(4) The eight angles with the largest rank (i.e., largest change in slope; rank 10 to 17) plus angles 0° and 180° will be the initial guess for the desired 10 angles for each measure. There are three sets of 10 angles, one for each measure. The rank data are stored in array NR.

(5) Using the selected 10 angles and linear interpolation, compute the difference between the original and interpolated data for each angle; i.e., compute the error. The error for the 10 selected angles will always be zero; thus, the RMS of the error is computed only for the nine remaining angles:

$$RMS = \frac{\sum (ERROR)^2}{9}$$

These error data are computed by subroutine ERR.

(6) Compute the error and RMS error described in step 5 above for each measure three times using the three sets of angles (step 4) for each measure. For example, for PNLTX compute the RMS of the error using the angles selected for PNLTX, ALX and ALTX. For each measure, save the angles, error data and RMS for the smallest RMS error (see statement label 150 and 200 loops).

(7) Determine the angle with the largest error using the error data in step 6 above (for one measure at a time). If this error is greater than ERMAX (ERMAX=1.49 dB), select this angle as one of the eight to be chosen and, one at a time, delete each of the eight angles previously selected computing the error and RMS error for each of the eight sets. Determine the best of the eight RMS values and, if better than the

RMS in step 6 above, revise the angle set for this measure. If no improvement is found, repeat the above using the second largest error greater than ERMAX. This step is performed by subroutine ITER called from this routine.

(8) Repeat step 7 above a maximum of five times (in subroutine ITER) or until all error are less than ERMAX (maximum of five passes including the second, third etc., largest error passes).

(9) Repeat steps 7 and 8 above for each of the three measures (label 200 loop).

(10) At this point we have revised sets of angles (compared with step 6 above) for a measure only if one or more errors were greater than ERMAX for that measure. If any angle sets have been revised, repeat steps 6 through 9 above using the new angle sets instead of those from step 4; otherwise, use angle sets selected in step 6 as final values for each measure. The repeat of steps 6 through 9 are computed by the statement label 220 and 230 loops which also use subroutines ERR and ITER.

(11) Return the angle set for each requested measure to the MAIN routine in array NR. The angle set consists of those angles whose rank is from 10 to 17 in array NR. Print error messages if the interpolation errors using these final selected angles exceed FMXER (default FMXER=5.0).

SUBROUTINE ERR(J,JA,NRA,RMSA,ERA,JM)

This subroutine is called from subroutines EDIT and ITER to compute the error data as described in step 5 in subroutine EDIT. The subroutine arguments are:

(1) J is the measure index of the original data.

(2) JA is the measure index in the rank (NRA), error (ERA) and RMS error (RMSA) arrays. JA indicates the angle set being used to interpolate the above J measure data.

(3) NRA, ERA and RMSA are defined in (2) above.

(4) JM is the variable dimension of arrays NRA, ERA and RMSA.

<u>Method</u>

Subroutine FINTP is called to linearly interpolate the PNdB or dBA levels of the nine angles with rank less than ten. The error data are then computed as follows:

$$ERA_{I,JA} = SENX_{I,J} - DBC_I$$

$$RMSA_{JA} = \left[\frac{1}{9} \sum_I \left(ERA_{I,JA} \right)^2 \right]^{1/2}$$

where

$ERA_{I,JA}$	=	the interpolation error in PNdB or dBA for the I^{th} angle and measure index JA.
$SENX_{I,J}$	=	the computed measure data in PNdB or dBA for angle I and measure J.
DBC_I	=	the interpolated measure value in PNdB or dBA for angle I.
$RMSA_{JA}$	=	the RMS error for measure index JA.

The above error data ($ERA_{I,JA}$) are zero for the eight angles with rank greater than nine; thus the RMS error are computed by dividing the sum of the error data by nine.

SUBROUTINE FINTP(AG,DBC,X,Y)

This is a linear interpolation subroutine called by subroutine ERR to interpolate the measure data for angles with rank less than ten. Arrays X and Y contain the angle and corresponding noise level data (PNdB or dBA) for angles 0 and 180 degrees plus the eight angles with rank greater than nine. Array AG contains the 19 angle values in ten degree increments from 0 to 180 degrees. Array DBC contains the noise level computed by this subroutine for the 19 angles.

Method

For angles defined in array X (rank greater than 9), DBC_J is set equal to the given noise level:

$$DBC_J = Y_L \qquad \text{PNdB or dBA}$$

where

DBC_J	=	noise level for the J^{th} angle.
Y_L	=	the given noise level corresponding to angle X_L which is the same as angle AG_J.

For angles which must be interpolated the linear interpolation function is:

$$DBC_J = Y_{L1} + \left(Y_L - Y_{L1}\right)\left(\frac{XI - X_{L1}}{X_L - X_{L1}}\right) \qquad \text{PNdB or dBA}$$

where

DBC_J	=	the interpolated noise level for the J^{th} angle.
XI	=	angle AG_J
L	=	the index of the first angle in array X greater than XI.
Ll	=	L - 1.
X_L	=	first angle greater than XI.
X_{L1}	=	first angle less than XI.
Y_L	=	given noise level corresponding to angle X_L.
Y_{Ll}	=	given noise level corresponding to angle X_{Ll}.

SUBROUTINE ITER(J,JMN,ICK,ERMAX,NRD)

This subroutine is called from subroutine EDIT to perform the interations described in steps 7 and 8 in subroutine EDIT. The subroutine arguments are:

(1) J is the index of the original measure data and of the rank (NRD) and RMS error (RMS) data.

(2) JMN is the index of the minimum error set in array ER.

(3) ICK is an error flag which is one when an error greater than ERMAX was found in this routine. This usually results in a change in rank (angles selected).

(4) ERMAX is a dB level defined in subroutine EDIT. An attempt is made to improve the angle selection for interpolation errors greater than or equal to this level.

(5) NRD is a dummy rank array.

SUBROUTINE RDFILE(NFRUN1,NFRUN2,)*

This subroutine is called from the MAIN routine when the command line variable ARGS in the MAIN routine is NULL. The subroutine arguments NFRUN1 and NFRUN2 are two twenty-four byte character variables used to store the NOISEFILE database filenames for military runup data. When the command line is NULL, these two filenames must be defined in the main routine. The asterisk in the argument list is an alternate RETURN label which is used to return control to the calling routine when an error has occurred.

This subroutine performs the following functions:

(1) Unit 1 is opened for I/O to the display;

(2) The program queries the operator for the OMEGA 11 setup filename which must be a standard DOS filename with a maximum of twelve characters. This file is opened on Unit 5 by the program. The ERRFLG is set to TRUE if the operator does not enter an existing filename.

(3) The program queries the operator for the profile dataset output filename which must be a standard DOS filename with a maximum of twelve characters. This file is opened on Unit 2 by program.

(4) The NOISEFILE database files with names stored in NFRUN1 and NFRUN2 are checked to be sure they exist. If they don't exist the ERRFLG is set to TRUE and the job is terminated. These files are not opened at this time.

(5) The list file is always opened on Unit 6 with filename OMEGA11.OUT. If this file already exists, the operator is queried for a new filename and given the option to terminate the job. If the job is terminated, the ERRFLG is set to TRUE.

SUBROUTINE CLFILE(NFRUN1,NFRUN2,ARGS,)*

This subroutine is called when the command line character variable ARGS contains filename information which must be decoded into the I/O filenames. This routine separates the command line string which may be up to 127 character long into the I/O filenames. This routine will only run when compiled with the Lahey compiler; it will not run with Microsoft FORTRAN which was formerly used with the OMEGA 11 program.

The subroutine arguments NFRUN1 and NFRUN2 are two twenty-four byte character variables used to store the NOISEFILE database filenames for military runup data.

The command line must contain five I/O filenames in the sequence listed here. Each file is described briefly as follows:

(1) The setup filename is decoded and opened on Unit 5.

(2) The list filename is decoded and opened on Unit 6.

(3) The profile dataset filename is decoded and opened on Unit 3.

(4) The first NOISEFILE database filename is decoded and stored in variable NFRUN1.

(5) The second NOISEFILE database filename is decoded and stored in variable NFRUN2.

Each filename must be separated by a space on the command line. The first byte on the command line must not be a space. If an error occurs when opening or checking a file, the ERRFLG is set to TRUE and the job is terminated. If only one NOISEFILE database is available and if all data to be analyzed are in this database, then this database filename may be entered in both filename fields on the command line. The two database files are never open at the same time.

BLOCK DATA

The BLOCK DATA routine is the last routine in this program. It is used to define numerous variables used in labeled common throughout the program. See the program listing in Appendix J and the list of symbols in this program documentation to identify the variables defined in BLOCK DATA.

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APPENDIX A
OMEGA 10 CODE SHEETS AND SETUP PROCEDURE

This appendix contains the standard procedure for setup and execution of the OMEGA 10 program which includes the OMEGA 10 program code sheets and a detailed description of each code sheet parameter and alphanumeric data field.

OMEGA 10 PROGRAM CODE SHEET

I. JOB CONTROL RECORD (One Per Job):

Col. 1 __ __ b __ __ __b __ __ DATE; eg 10 JUN 93
11 __ __ __ __ __ __ DATN; Data in DAMOYR form, e.g., 100693
18 ____ IPR [0 -- no print]
20 ____ MEAS(1) EPNL [0 for IPR=0; 1 for IPR=1]
22 ____ MEAS(2) ALM [0 for IPR=0; 1 for IPR=1]
24 ____ MEAS(3) SEL [1 for IPR=0; 1 for IPR=1]
26 ____ IPU [1 for IPR=0; 0 for IPR=1]

II. OUTPUT PARAMETERS FOR EACH AIRCRAFT (2 or 3 Records):

Record #1

Col. 1 __ __ __ ACC
4 __ __ __ ITEMP [59°F]
7 __ __ __ IRHUM [70%]
11 ________ PV [w]
13 ________ CRI [0]
15 __ __ __ __ __ DELN [0.0]
20 __ __ NP
22 __ __ __ __ __ __ PSU (left justify)

Record #2 (Profile Output Power Data)

Col. 1 __ __ __ __ __	PSC #1	Col. 6 __ __ __	VX	Col. 9 __ __	OPCR	Col. 11 __ __	OPCC [81]
13 __ __ __ __ __	PSC #2	18 __ __ __	VX	21 __ __	OPCR	23 __ __	OPCC [82]
25 __ __ __ __ __	PSC #3	30 __ __ __	VX	33 __ __	OPCR	35 __ __	OPCC [83]
37 __ __ __ __ __	PSC #4	42 __ __ __	VX	45 __ __	OPCR	47 __ __	OPCC [84]
49 __ __ __ __ __	PSC #5	54 __ __ __	VX	57 __ __	OPCR	59 __ __	OPCC [85]
61 __ __ __ __ __	PSC #6	66 __ __ __	VX	69 __ __	OPCR	71 __ __	OPCC [86]

Record #3 (Profile Output Power Data Conti.; required only when NP>6)

Col. 1 __ __ __ __ __	PSC # 7	Col. 6 __ __ __	VX	Col. 9 __ __	OPCR	Col. 11 __ __	OPCC [87]
13 __ __ __ __ __	PSC # 8	18 __ __ __	VX	21 __ __	OPCR	23 __ __	OPCC [88]
25 __ __ __ __ __	PSC # 9	30 __ __ __	VX	33 __ __	OPCR	35 __ __	OPCC [89]
37 __ __ __ __ __	PSC #10	42 __ __ __	VX	45 __ __	OPCR	47 __ __	OPCC [90]
49 __ __ __ __ __	PSC #11	54 __ __ __	VX	57 __ __	OPCR	59 __ __	OPCC [91]
61 __ __ __ __ __	PSC #12	66 __ __ __	VX	69 __ __	OPCR	71 __ __	OPCC [92]

(Right Justify "PSC" Data)

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(1) Repeat section II for each aircraft set in the job.
(2) [ ] -- Program default values for the above parameters.
(3) See Standard Procedure for Setup and Execution of the OMEGA 10 Program for above parameter definitions.

STANDARD PROCEDURE FOR SETUP AND EXECUTION OF THE OMEGA 10 PROGRAM

1) The OMEGA 10 setup deck must contain the following:

   (a) One job control record:

   (b) One, two or three output parameter records for each set of profile data for each aircraft.

   The parameters required for each record are listed on the OMEGA 10 code sheet and described in detail in Steps 2 and 3 below.

2) Fill in the OMEGA 10 code sheet job control record parameters where default conditions do not apply (code sheet Item I). The required parameters are defined as follows:

   (a) The DATE in columns 1 to 9 will be printed on all output pages and in the first comment line in each profile dataset (9 alphanumeric characters).

   (b) The date in the day, month, year form (DATN) in columns 11 to 16 is printed as part of the run identification on all the plot pages (G, J, K, N, and O). It is not used in the no-print mode and thus may be left blank on the code sheet.

   (c) The value of IPR (integer) sets the print (IPR=l) or no-print (IPR=0 or blank) mode of the OMEGA 10 job. In the no print mode (default), only error messages and the summary page are printed on the OUTPUT file (Unit 6) and only the measure(s) requested on the code sheet is computed. In the print mode, all seven measures are computed and all output are printed on the OUTPUT file.

   (d) The MEAS(l), MEAS(2) and MEAS(3) parameters (integers) determine which noise measures (EPNL, ALM and SEL respectively) are computed by the program. In the print mode (IPR=l), all three are always set equal to one by the program because all three measures are required; thus they may be left blank on the code sheet. In the no-print mode (IPR=0 or blank), measure data will be computed only for the one or more MEAS parameters which are greater than zero (default is MEAS(3)=l and SEL is computed). Note that the PNL, PNLT, SELT and ALT noise measures are always computed and printed in the print mode; however they cannot be written to the profile dataset file opened on Unit 3.

   (e) IPU (integer) controls the printing of the profile datasets to the file opened on Unit 3. For IPU equal blank or zero (default for IPR=l), no data are written to Unit 3. For IPU equal to one (default for IPR=0 or blank), all requested profile data are written to Unit 3.

3) Fill in the OMEGA 10 code sheet output parameters for each aircraft where default parameters do not apply (code sheet Item II). One, two, or three records are required for each aircraft set depending on the value of NP defined below. The required parameters are defined as follows:

(a) ACC must be a three character numeric aircraft code. ACC is part of the profile dataset COMDECK name and part of the output profile identification required by the NOISEMAP program. It is also used to search the reference file for the required reference data.

(b) ITEMP and IRHUM (integers) are the output temperature (°F) and relative humidity (%), respectively. The default values listed on the code sheet are for standard day conditions.

(c) PV is an alphanumeric profile version code (usually alpha) which is printed on all output and is the second last character in the profile COMDECK name. One function of PV would be to make COMDECK names unique when the same aircraft data are run for different weather conditions (NOISEMAP does not read the PV code).

(d) CRI is an alphanumeric COMDECK revision identifier (usually integer) which is printed on the summary page and is the last character in the profile COMDECK name. CRI is designed to make COMDECK names unique when several revisions of the same data are computed. The CRI default value will normally apply (not read by the NOISEMAP program).

(e) DELN (or "DELTA N") is the dB level to be added to all reference data for this aircraft (floating point or right justified integer). It is printed on the summary profile data pages and is typically used to adjust data for multiple engines.

(f) NP is the number of power settings (PSC's) to be computed for this ACC. If NP is zero or blank, profile data are computed for all operation power codes (for ACC) in the reference file (max of 15) with the reference file airspeed and power settings; also the output operation power codes (OPCC) are the same as the operation power codes in the reference file (that is, for NP=0, records two and three are not read by the program). The NP entered in the setup file must be an integer less than or equal to 12.

(g) PSU is the power setting unit which applies to the PSC data. PSU is also used to select the reference file power setting data; thus it must exactly match (including blanks) one of the units in the reference file or the ACC data will be terminated. PSU must be left justified in the 6 character field (alphanumeric). For the NP=0 option, the PSU field may be left blank in which case the data for the first power setting will be used to compute the profile data.

(h) The PSC's are the power setting values for which profile data are computed. The PSC data may be listed as integer or floating point in any desired sequence, but in either case must be right justified in the five character field. Note that each

reference dataset contains the source power setting in one, two, or three different units in the third comment record. The PSU parameter described in item 3g above specifies which of these power settings the OMEGA 10 program will use to interpolate the profile data. The PSC's are printed in the third comment record in each profile dataset, on all profile output pages, and on the summary page.

(i) The VX's are the airspeed values (right justified integers) in knots to which the profile data are adjusted. They are printed in the first comment line in each profile dataset, on all profile data output pages, and on the final summary page.

(j) The OPCR's (numeric with leading zero) are reference file operation power codes which determine the operation power descriptions of the profile data and the reference points (SEL, ALM, or EPNL versus power setting) from which the measure data for the PSC power settings are interpolated or extrapolated (the slope line passes through this reference point). The COMDECK names of the reference file datasets for this reference point and for the two slope points are printed on the summary page.

(k) The OPCC's are two character numeric operation power codes assigned to the output profile data. The OPCC are part or the COMDECK name and are also part of the profile identification used by the NOISEMAP program. Default values are 81 to 92. For NP equal to zero, the OPCC's are set equal to be reference file OPC'S.

4) The following comments apply to the PSC and OPCR data:

(a) Each reference dataset is labeled with an interpolation type code of I, N or P. This interpolation type code which is included as the last character in the COMDECK name is described in the reference dataset format description in Appendix E. For all OPCR's with interpolation type code N the PSC power setting must be the same as the reference file power setting or the PSC data will be deleted from the run; that is, no extrapolation or interpolation is permitted for these OPCR's.

(b) When the PSC power setting is the same as the reference file power setting designated by OPCR, then only the OPCR reference file data are required to compute the PSC profile data. For all other cases where PSC is not the same, at least one additional reference file dataset is required. It is assumed here that the individual completing the code sheet is familiar with the interpolation/extrapolation requirements and limitations.

5) Repeat Step 3 above for each set of profile data for each aircraft in the job. If two or more sets of profile data are required for the same aircraft because of additional PSC's or different DELN or weather data, the program uses the reference data read for the previous set and thus avoids searching the reference file for the same data. Since NOISEMAP uses an ID composed of the ACC and OPCC codes, computer jobs run for NOISEMAP input can not use the default OPCC for multiple sets for the same ACC; default OPCC's will not provide unique ID's for NOISEMAP. For jobs unrelated to NOISEMAP, PV or CRI codes can be used to make the COMDECK names unique.

6) The program will read the reference data from the file opened on Unit 7. These data must be on disk in the format described in Appendix E. The program rewinds the Unit 7 file before searching for the aircraft (ACC) data; thus, aircraft sequence is not important in the OMEGA 10 job or on the Unit 7 file (all data for each aircraft must be back to back in the Unit 7 file). The program reads and stores all reference data for all operation power codes (MAX of 15) available in the reference file for aircraft ACC. If the reference file contains more than 15 operation power codes for aircraft ACC, a warning message is printed and only the first 15 are read and stored by the program.

7) Execution of the OMEGA 10 program requries approximately 150K of memory.

8) After execution of the computer job, the following data are available:

   (a) The summary pages and all other list output are in the default OMEGA108.OUT output file or in the file opened for list output on Unit 6.

   (b) The profile data are in the file opened on Unit 3. There is no default file name.

9) Data for aircraft code ACC will be deleted from the computer job and an error message printed when one or more of the following problems occur (ERRFLG is set to TRUE):

   (a) The PSU from the code sheet doesn't match any of the available power setting units for ACC in the reference file.

   (b) There is an error in the operation power code, aircraft code, or record sequence in one or more reference file data records.

   (c) The reference file minimum slant range is not within 1% of a standard profile distance.

   (d) No reference data were found for this aircraft in the reference file.

10) Data for operation power code OPCC will be deleted from the aircraft set and an error message printed when one or more of the following occur (ERRFLG is set to TRUE):

   (a) There is insufficient data for extrapolation or interpolation to the PSC power setting.

   (b) The reference file and the PSC power settings are not equal as required for this OPCR.

   (c) The reference operation power code (OPCR) was not found in the reference file.

11) Warning messages are printed when one or more of the following occur (ERRFLG is set to TRUE):

   (a) The reference file contains more than 15 datasets; only the first 15 are read for this aircraft.

(b) The reference file minimum slant range is not equal to 1000 feet for all aircraft and 250 feet for some helicopters as assumed by the program in subroutines DELTA6 and PPFDAT. The extrapolation limit check is always computed at 1000 feet even for these helicopter data. This will probably be corrected/updated when the helicopter procedure is finalized.

12) The entire computer job is terminated when an end of file is read from the input file. This is the normal job termination.

APPENDIX B
OMEGA 11 CODE SHEETS AND SETUP PROCEDURE

This appendix contains the standard procedure for setup and execution of the OMEGA 11 program which includes the OMEGA 11 program code sheets and a detailed description of each code sheet parameter and alphanumeric data field.

OMEGA 11 PROGRAM CODE SHEET

I. JOB CONTROL RECORD (One Per Job):

Col. 1 __ __ b __ __ __b __ __ DATE; eg 10 JUN 93
12 ____ IPR [0]
13 ____ IEDIT [0]
16 ____ MEAS(1) PNLT [0]
18 ____ MEAS(2) AL [0]
20 ____ MEAS(3) ALT [0]
21 __ __ __ __ __ FMXER [5.0 dB]

II. OUTPUT PARAMETERS FOR EACH AIRCRAFT (2 Records):

Record #1

Col. 1 __ __ __ ACC
8 __ __ __ IT8[59°F]
11 __ __ __.__ __ P8[29.92 IN HG]
18 __ __ __ IH8[70%]
22 ______ PV[W]
24 ______ CR[0]
26 __ __ __ __ __ DELN[0.0]

Record #2 (Profile Output Power Data)

Col. 1 ____ NP
2 __ __ __ __ __ __ __ PSU (Left Justify)

11	__ __ __ __ __	PSC #1	Col. 17	____	IFC	Col. 19	__ __	OPCC[91]
21	__ __ __ __ __	PSC #2	27	____	IFC	29	__ __	OPCC[92]
31	__ __ __ __ __	PSC #3	37	____	IFC	39	__ __	OPCC[93]
41	__ __ __ __ __	PSC #4	47	____	IFC	49	__ __	OPCC[94]
51	__ __ __ __ __	PSC #5	57	____	IFC	59	__ __	OPCC[95]
61	__ __ __ __ __	PSC #6	67	____	IFC	69	__ __	OPCC[96]

(Right Justify "PSC" and weather data)

SECOND AIRCRAFT

Record #1

Col. 1 __ __ __ ACC
8 __ __ __ IT8[59°F]
11 __ __ __.__ __ P8[29.92 IN HG]
18 __ __ __ IH8[70%]
22 ______ PV[W]
24 ______ CR[0]
22 __ __ __ __ __ DELN[0.0]

Record #2

Col. 1 ____ NP
2 __ __ __ __ __ __ __ PSU (Left Justify)

11	__ __ __ __ __	PSC #1	Col. 17	____	IFC	Col. 19	__ __	OPCC[91]
21	__ __ __ __ __	PSC #2	27	____	IFC	29	__ __	OPCC[92]
31	__ __ __ __ __	PSC #3	37	____	IFC	39	__ __	OPCC[93]
41	__ __ __ __ __	PSC #4	47	____	IFC	49	__ __	OPCC[94]
51	__ __ __ __ __	PSC #5	57	____	IFC	59	__ __	OPCC[95]
61	__ __ __ __ __	PSC #5	67	____	IFC	69	__ __	OPCC[96]

(1) Repeat section II, records 1 and 2 for each aircraft set in the job.
(2) [ ] -- Program default values for the above parameters.
(3) See Standard Procedure for Setup and Execution of the OMEGA 11 Program for parameter definitions.

STANDARD PROCEDURE FOR SETUP AND EXECUTION OF THE OMEGA 11 PROGRAM

1) The OMEGA 11 setup deck must contain the following:

   (a) One job control record;

   (b) Two output parameter records for each set of profile data for each aircraft.

   The parameters required for each record are listed on the OMEGA 11 code sheet and described in detail in Steps 2 and 3 below.

2) Fill in the OMEGA 11 code sheet job control parameters where default conditions do not apply (code sheet Item I). The required parameters are defined as follows:

   (a) The DATE in columns 1 to 9 will be printed on all output pages and in the first comment line in each profile dataset (9 alphanumeric characters).

   (b) The value of IPR determines the quantity of list output written to the file opened on Unit 6. If IPR is zero or blank, only the summary page and program error messages are printed for each aircraft. If IPR is greater than zero, all list output are printed (IPR must be an integer).

   (c) The value of IEDIT determines the quantity of profile dataset output written to the file opened on Unit 2. If IEDIT is zero or blank, the profile datasets for each requested measure contain data for the 10 angles which best define the profile data (using linear interpolation) from 0° to 180°. If IEDIT is greater than zero, profile data for all 19 angles are written to Unit 2; for IEDIT less than zero, all profile data are omitted from Unit 2 (IEDIT must be an integer).

   (d) The MEAS(l), MEAS(2) and MEAS(3) parameters determine which noise measures (PNLT, AL and ALT respectively) are computed by the program. If all three are zero or blank, all measures are computed; otherwise, only measures corresponding to MEAS greater than zero are computed (all MEAS must be integer).

   (e) The value of FMXER is the maximum linear interpolation error permitted in the angle selection routine. For errors greater than FMXER, error messages are printed but the aircraft analyses are not terminated. Typically, the largest error in a relatively smooth profile is 1.0 to 1.5 dB or less. FMXER which applies only when IEDIT is zero or blank must be listed as a floating point number or right justified integer (default is 5.0 dB).

3) Fill in the OMEGA 11 code sheet output parameters for each aircraft where default parameters do not apply (code sheet Item II). The required parameters are defined as follows:

(a) ACC must be a three character numeric aircraft code. ACC is part of the profile dataset COMDECK name and part of the output profile identification required by the NOISEMAP program. It is also used to search the reference file for the required reference data (see Step 4 below regarding multiple sets for the same aircraft code).

(b) IT8, P8 and IH8 are the output temperature (°F), barometric pressure (in Hg) and relative humidity (%) respectively. The default values listed on the code sheet are for standard day conditions. IT8 and IH8 must be integers and P8 must be floating point.

(c) PV is an alphanumeric profile version code (usually alpha) which is printed on all list output and is the second last character in the profile COMDECK name. One function of PV would be to make COMDECK names unique when the same aircraft data are run for different weather conditions (NOISEMAP does not read the PV code).

(d) CRI is an alphanumeric COMDECK revision identifier (usually integer) which is printed on the summary page and is the last character in the profile COMDECK name. CRI is designed to make COMDECK names unique when several revisions of the same data are stored in a database. The CRI default value will normally apply (not read by the NOISEMAP program).

(e) DELN (or "DELTA N") is the dB level to be added to all reference data for this aircraft (floating point or right justified integer). It is printed on the summary and reference data pages and is typically used to adjust data for multiple engines.

(f) NP is the number of power settings (PSC's) to be computed for this ACC. If NP is zero or blank, profile data are computed for all operation power codes (for ACC) in the reference file; also the output operation power codes (OPCC) are the same as the operation power codes in the reference file (that is, for NP=0, record 2 columns 2 to 70 are not read by the program). NP must be an integer less than or equal to 6.

(g) PSU is the power setting unit which applies to the PSC data. PSU must exactly match (including blanks) one of the units in the reference file or the ACC data will be terminated. PSU must be left justified in the 6 character field (alphanumeric). Note that the program checks all available power setting data in the reference file.

(h) The PSC's are the power setting values for which profile data are computed. All PSC values must lie within the extremes available in the reference file. For uniformity, list special case PSC data (IFC=l) first followed by the normal PSC data (IFC=0); each in sequence from low to high (not required by the program). The PSC data may be listed as integer or floating point, but in either case must be right justified in the five character field. Note that each reference dataset contains the source power setting in one, two, or three different units in the third comment record. Any available power setting (value and units) may be used to interpolate the profile data.

(i) IFC is a program flag used to separate the AFTERBURNER, WET, WITH JETS and helicopter special case data from the normal power data. IFC must be zero or blank for normal data and one (1) for special case data. For special case data (IFC=l), no interpolation is permitted and thus PSC must be exactly the same as the power setting in the normalized file. There are currently 14 special case power settings which are identified by their operation power codes. The 14 speical case codes are: 01, 02, 03, 10, 35, 38, 42, 49, 60, 61, 62, 63, 64 and 65.

(j) The OPCC are two character numeric operation power codes assigned to the output profile data. The OPCC are part of the COMDECK name and are also part of the profile identification used by the NOISEMAP program. Default values are 91 to 96.

4) Repeat Step 3 above for each set of profile data for each aircraft in the job. If two or more sets of profile data are required for the same aircraft because of additional PSC's or different DELN or weather data, ACC should be set equal to "***"; however, all other parameter must be defined or default conditions apply. When ACC=***, the program uses the reference data read for the previous set and thus avoids searching the reference file for the same data. Since NOISEMAP uses an ID composed of the ACC and OPCC codes, computer jobs run for NOISEMAP input can not use the default OPCC for multiple sets for the same ACC; default OPCC's will not provide unique ID's for NOISEMAP. For jobs unrelated to NOISEMAP, PV or CRI codes can be used to make the COMDECK names unique.

5) The program will read the reference data from the file opened on Unit 7. These data must be on disk in the format described in Appendix G. The program rewinds the Unit 7 file before searching for the aircraft (ACC) data; thus, aircraft sequence is not important in the OMEGA 11 job or in the dataset file. However, all data for each aircraft must be back to back in the reference dataset. The program reads and stores all reference data for all operation power codes (MAX of 6) available on the reference file for aircraft ACC. If this reference file contains more than six operation power codes for aircraft ACC, all computations for that aircraft are terminated (one exception: if all IFC=0, special case data are not stored). The first Test number and Noise Source/Subject description read from the reference file (Unit 7) are the Test and Noise Source/Subject description used for this set of profile data for this aircraft. Run number is assigned from 01 to 06 in the sequence of the PSC output.

6) After execution of the computer job, the following data are available:

(a) The summary pages and all other computer printouts are on file OMEGA11.OUT or the file opened on Unit 6 as the list output file.

(b) The profile data are in the file opened on Unit 2. There is no default profile dataset file.

7) Execution of the OMEGA 11 program requires approximately 150K of memory.

8) Data for aircraft code ACC will be deleted from the computer job and an error message printed when one or more of the following problems occur (ERRFLG is set to TRUE):

(a) No reference data are found for ACC in the reference file opened on Unit 7.

(b) The Unit 7 file contains data for more than the maximum (6) number of operation power codes for ACC.

(c) Error in reference dataset input caused by missing or extra data records (angle ID errors).

(d) The PSU from the code sheet doesn't match any of the power setting units for ACC in the reference file.

(e) The requested special case power setting (PSC for IFC=1) was not found in the reference file.

(f) One or more requested power settings (PSC's) are outside the range of the power setting data available in the reference file.

9) The entire computer job will be terminated when either of the following occur (ERRFLG is set to TRUE):

(a) The number of power settings requested (NP) is greater than the maximum number permitted (NPM=6). An error message will be printed.

(b) An end of file is read from this input file. This is the normal job termination.

APPENDICES C THROUGH K MAY BE OBTAINED BY REQUEST TO:

AL/OEBN
2610 SEVENTH ST.
WRIGHT-PATTERSON AFB OH 45433-7901